"I would have everie man write what he knowes and no more."—MONTAIGNE

BRITISH JOURNAL OF ANAESTHESIA

VOL. XXVII, No. 8 AUGUST 1955

EDITORIAL

THE recent issue of *The Medical Use of Hypnotism* calls our attention once more to this interesting subject. Accordingly we are publishing our article, "Hypnotism and the Anaesthetist" by Dr. A. Owen-Flood. It would appear that Dr. Owen-Flood, possibly quite rightly, makes no attempt to suggest that hypnotism is more suitable than the present methods used for producing anaesthesia for major surgery, but that anaesthetists, because of their special skill in anaesthesia are particularly well placed to become hypnotists.

The majority of anaesthetists are so fully occupied with the current techniques that they are unlikely to find time and opportunity for the practice of hypnosis. Nevertheless there are some so situated that if they took the trouble to acquire the necessary skill, might easily find opportunity to exercise that skill in suitable cases. Dr. Owen-Flood gives a number of such opportunities. He mentions childbirth, epilepsy, auto-erotism, somnambulism, nocturnal enuresis, the removal of anxiety. He does not record many "cases" but he does give an account of a well-worth-while improvement in a number of his cases. As we do not understand the nature of hypnotism, it is obvious that research in the subject is much needed and a deeper insight springing therefrom may well reveal possibilities of a wider and more successful application.

THE portrait on the front of our cover this month is that of Dr. Alexander Wood. He was born in 1817 and died in 1884. In 1858 he was elected President of the Royal College of Physicians of Edinburgh, and at the end of that time was re-elected for another year.

He is generally recognized as the inventor of the hypodermic syringe. There seems to have been a number of other claimants to this honour. For a long and detailed account of these claims and the usual vanity and childishness of mankind exhibited in connection with the same, our readers are referred to the excellent article by Norman Howard Jones, "A Critical Study of the Origins and Early Development of Hypodermic Medication", in the *Journal of the History of Medicine* (Vol. 2, 1947). Summing up, he has this to say: "Wood devised the technique of hypodermic injection in 1853 and introduced (1855) it as a therapeutic procedure. His intention was to secure a local analgesic action on peripheral nerves, and although he clearly recognized the occurrence of systemic effects, he failed to appreciate their significance." Howard Jones adds that it was Hunter who first used the word "hypodermic" to distinguish his use of subcutaneous injection as a mode of systemic administration from Wood's use of the same technique for its supposed local action.

EDITORS' NOTE

THE substance referred to in the first two papers in this issue has been marketed by Parke Davis and Co. as Surital and by Eli Lilli and Co. as Thioseconal. It has as yet no official name in this country, although it has appeared in the literature as thioquinal barbitone. Thiamylal Sodium is an official name for the substance in the U.S.A.; it appears as such in the list of New and Non-official Remedies published by the American Medical Association, and this is used in these articles pending a decision in respect to its name by the B.P.C. Strictly speaking in this text the full name "Thiamylal Sodium" should appear, but as the abbreviation of "Thiopentone Sodium" to "Thiopentone" has become customary, a similar shortening of "Thiamylal Sodium" to "Thiamylal" is probably permissible.

Brit. J. Anaesth. (1955), **27**, 374

COMPARATIVE POTENCIES OF THIAMYLAL (SURITAL) AND THIOPENTONE

BY

WILLIAM W. MUSHIN, ALEXANDER G. HENDERSON

AND

WILLIAM W. MAPLESON

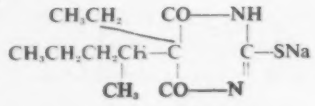
The Department of Anaesthetics
Welsh National School of Medicine, Cardiff

THE pharmacological effects of thiamylal have already been studied in animals (Wyngaarden *et al.*, 1949; Woods *et al.*, 1948). This paper describes experiments directed at defining more clearly the potency of this drug in relation to thiopentone.

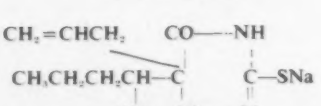
The chemical structure of thiamylal is basically similar to that of thiopentone. Whereas the latter is the sodium salt of thiopentobarbitone, thiamylal is the sodium salt of thio-quinalbarbitone. In the United States the substance is known under the trade name of Surital.

In thiamylal an allyl group replaces the ethyl group of the thiopentone molecule.

Thiopentone



Thiamylal



Thiamylal is a light yellow anhydrous crystalline substance like thiopentone, in taste resembling somewhat that of onions or garlic. It is readily soluble in water forming a solution of pH 10 to 10.5, and stable up to about 6 hours. These characteristics are much the same as thiopentone and extravenous or intra-arterial injections of this substance probably carry the same risks as those of thiopentone.

In its pharmacological effects thiamylal is similar to thiopentone, but is said to be more potent. Thus Wyngaarden *et al.* (1949) found that in dogs it was 1½ times more potent than thiopentone. They also showed that, as in the case of thiopentone, the primary cause of death was respiratory failure. When comparing "rates of detoxification" they found that thiamylal was destroyed more rapidly than thiopentone. Otherwise the two drugs resembled each other fairly closely.

A considerable clinical experience of the drug has accumulated. Dornette and Tuohy (1951) used thiamylal in 1,200 cases, Helrich *et al.* (1950) in 1,200, Lund (1954) in 6,000, Dillon *et al.* (1950) in 700, Kirchoff (1951) in 150 and Bryce-Smith *et al.* (1954) in 3,000. These

authors all came to the conclusion that thiamylal was a satisfactory alternative to thiopentone in clinical practice, with approximately the same effects and recovery rates as the latter drug, but with some slight increase in potency. Lund (1954) on the basis of his extended experience went further and summarized his clinical impressions as follows. He found that with thiamylal there was (1) less respiratory depression, (2) less hypersensitivity of the laryngeal and other respiratory reflexes, (3) more rapid recovery, (4) less rise in pulse rate.

PRESENT EXPERIMENTAL METHOD

In order to compare the potency of thiamylal with thiopentone for ourselves, a pilot experiment was designed, utilizing the common use of intravenous barbiturates in preceding modified electroconvulsion therapy. A number of such patients were given thiamylal on some occasions and thiopentone on others. Thus the effects of the two drugs could be compared not only as between patient and patient, but also on the same patient. In addition experimental errors of observation were minimized since in the majority of cases each patient had each drug on more than one occasion.

In this series each electroconvulsion was preceded by an intravenous injection of either thiopentone or thiamylal, the dose of each drug administered being calculated on the basis of 25 mg per stone (14 lb) body weight. This dosage was chosen as being a suitable "sleep dose" based on our experience of thiopentone and on the published reports of thiamylal. The dose was adjusted to the nearest 0.5 ml of a 5 per cent solution. The barbiturate was immediately followed by a fixed dose of 50 mg of suxethonium (Brevedil E) intravenously. When all muscle twitching had ceased the shock was administered. Ventilation during any apnoeic period was maintained by rhythmic squeezing of a rubber bag containing oxygen, until spontaneous respiration was established.

The following observations were carefully made:

(1) The "time of injection" of the barbiturate.

(2) The "time of falling asleep".

(3) The "time of administering the electroconvulsion shock".

(4) The "time of awakening" or commencement to react to stimuli.

These times were measured in seconds from the time of injection of the barbiturate, which was regarded as zero. In order to determine the time of falling asleep the patient was asked to hold up one arm and when this dropped the time was noted. After the shock had been given the patient was ventilated with a rich oxygen mixture until spontaneous respiration occurred. He was then pricked repeatedly with a pin on the back of his hand until reaction occurred, shown usually by withdrawal of the hand, and this time was also noted. Spontaneous respiration was always well established before reaction to stimulation occurred. This minimized the possibility that the "time of reaction" coincided with recovery from the effects of the relaxant.

The results are given in table I. From these the various graphs were constructed, and statistical tests made.

TABLE I

Patient	Age in years	Weight in stones	Calculated dose of barbiturate		Actual dose of barbiturate		Thiopentone				Thiamylal			
			Grammes	c.c. of 5% solution	Grammes	c.c. of 5% solution	Mean time of falling asleep in seconds	Mean time of shock in seconds	Mean time of reaction in seconds	Number of observations	Mean time of falling asleep in seconds	Mean time of shock in seconds	Mean time of reaction in seconds	Number of observations
F.S.	48	12.3	0.307	6.1	0.300	6.0	19	43	263	3	22	47	248	4
R.W	50	7.4	0.186	3.7	0.175	3.5	18	46	262	2	34	50	355	1
C.L.	64	8.8	0.220	4.4	0.225	4.5	38	60	379	5	31	61	405	3
W.B.	47	9.4	0.234	4.7	0.225	4.5	26	39	167	3	27	45	163	2
P.H.	51	10.1	0.252	5.0	0.250	5.0	24	47	270	2	22	48	353	2
W.R.	49	11.7	0.293	5.8	0.300	6.0	29	47	245	2	26	52	260	1
P.W.	39	10.0	0.250	5.0	0.250	5.0	25	46	575	1	35	52	645	1
I.C.	40	8.4	0.209	4.2	0.200	4.0	23	43	146	3	23	35	190	2
H.V.	38	9.0	0.225	4.5	0.225	4.5	28	43	158	2	25	44	135	1
M.W	62	8.6	0.214	4.3	0.225	4.5	30	47	260	3	30	53	262	3
E.H.	61	11.4	0.284	5.7	0.275	5.5	43	60	160	2	34	56	289	3
P.F.	57	6.9	0.168	3.4	0.175	3.5	22	38	253	3	26	42	244	4
J.B.	51	10.4	0.260	5.2	0.250	5.0	28	60	269	1	29	47	205	1
J.G.	69	10.4	0.260	5.2	0.250	5.0	33	46	209	2	40	63	173	2
P.D.	54	9.6	0.239	4.8	0.250	5.0	31	47	190	2	26	35	240	3
J.L.	25	12.1	0.304	6.1	0.300	6.0	35	50	175	1	35	50	214	1

DISCUSSION OF RESULTS

Duration of sleep.

Figure 1 suggests that on the average the patients slept longer after thiamylal than after thiopentone.

If the differences between the mean durations of sleep after the two drugs (thiamylal minus thiopentone) for each patient are weighted according to the number of individual observations from which they were derived, then the mean difference, $\bar{x} = 23.7$ sec, and the estimate, s', of the standard deviation of the parent population of which these observations form a sample is 48.9 sec. Suppose this value of $\bar{x}$ arose by chance fluctuations in this sample from a true value of zero in the parent population. Then "Student's" $t = \left(\frac{\bar{x}}{s'}\sqrt{n}\right) = 1.94$ with 15 degrees of freedom which is suggestive but not significant ($P = 0.072$).

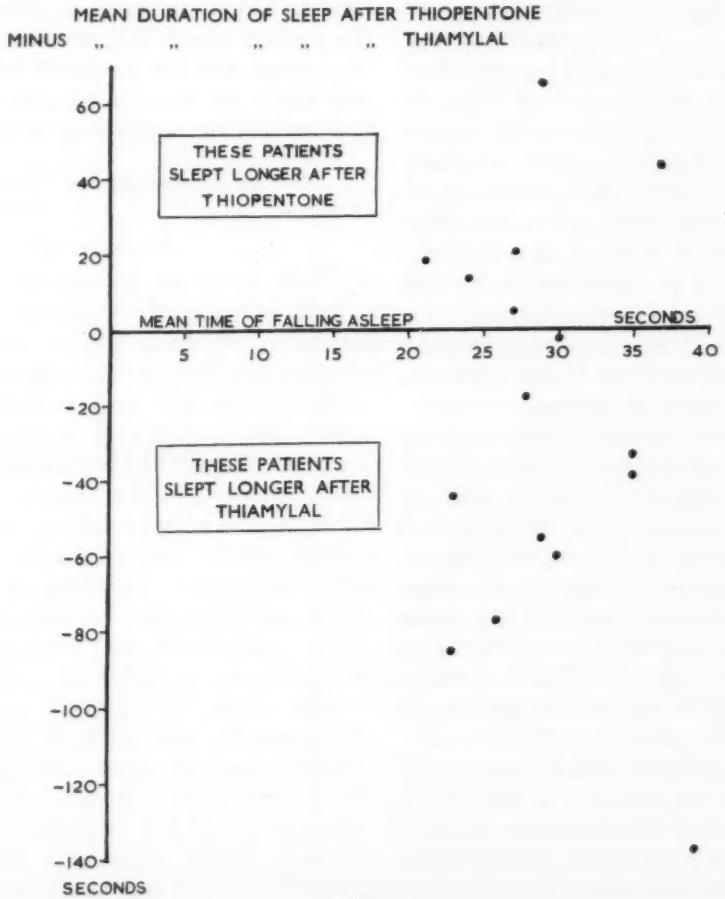


FIG. 1

Thus there is some suggestion that patients tend to sleep longer after thiamylal than after thiopentone although the present results would not firmly contradict a hypothesis that on the average patients sleep equally long after both drugs.

Effect of Relaxant.

The recovery time from a barbiturate may be influenced by the simultaneous administration of a relaxant. The dose of relaxant was the same for all patients (50 mg suxethonium). Therefore the dose per unit body weight varied inversely with the weight of the patient. It might be argued that, in the case of the lighter patients, i.e. those having a relatively larger dose of relaxant, the time of awakening might be delayed because of the effect of the relaxant. If such variation in dosage of relaxant had the same effect with both drugs it would not affect the validity of the conclusion reached above that patients probably tend to sleep longer after thiamylal than after thiopentone.

It is possible though unlikely that the influence of the relaxant in these experiments was different for the two barbiturates. The existence and significance of such a difference can be tested by examining the correlation between body weight and the difference between the mean durations of sleep after the two drugs in each patient (fig. 2). The correlation coefficient is 0.06 which is not significantly different from zero ($P = 0.83$).

The next question which arises in connection with the relaxant is whether the dose of this drug affects the time at which the shock was given. Our clinical experience gave the impression that a relatively smaller dose, because of the slightly more prolonged fibrillation, delayed the time at which the shock was given.

This can be tested by examining the correlation between weight and mean time of shock with thiamylal and with thiopentone in each patient (fig. 3). Using weighted means, the correlation coefficient is 0.23 which is not significantly different from zero ($P = 0.21$). Thus even in a long series, the variation in the dose of relaxant per unit body weight may not affect the time at which the shock is given. Thus the present results do not contradict the hypothesis that the weight of the patient and hence the dose of relaxant per unit body weight has no effect on the difference

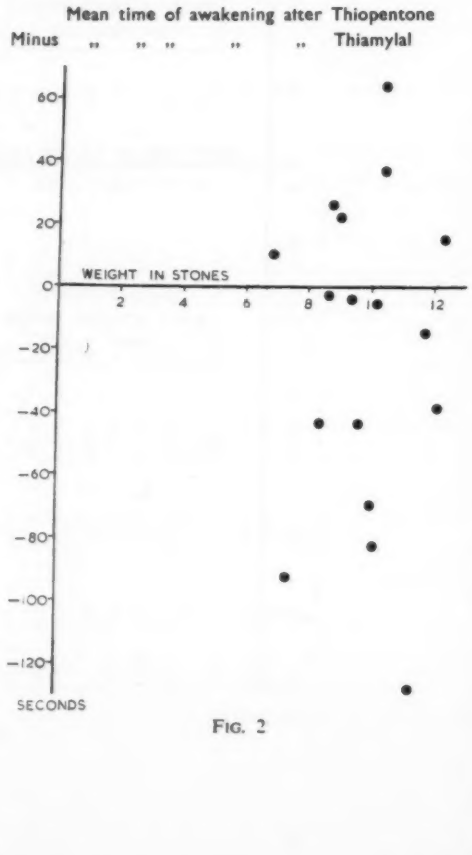


FIG. 2

between the mean durations of sleep after the two drugs.

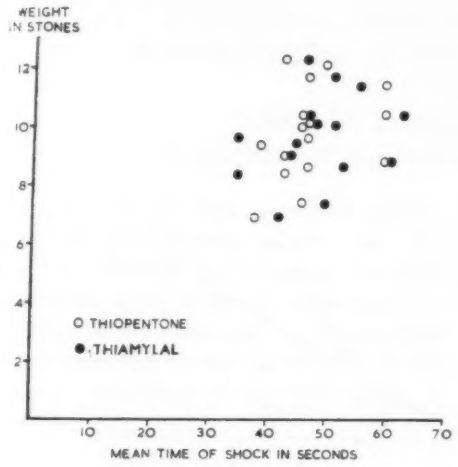


FIG. 3

Effect of time of shock.

Does the time of the shock affect the duration of sleep? The possible effect of the shock causing some postconvulsion narcosis cannot be ignored in considering the duration of sleep. On some occasions, not included in these experiments, when a dose of barbiturate similar to that given here was administered in the absence of a shock, the awakening time was markedly shorter. Also as is well known, patients having unmodified electro-convulsion therapy without barbiturates are unconscious for some time afterwards.

This may be tested by examining the correlation between the mean time of shock and the mean time of awakening, combining the results for both drugs in each patient (fig. 4). This gives a correlation coefficient of 0.46. The probability that this value would arise by chance from an uncorrelated parent population is 0.077 which is suggestive but not significant.

Thus there is some suggestion that the later the shock is given the later the patient awakes and therefore the longer is the duration of sleep. As an estimate of the nature of this relationship the regression coefficient of y (time of awakening, fig. 4) on x (time of shock) may be determined. This is 5.8. That is to say that if the shock is delayed by say 1 second the awakening will be delayed by 5.8 seconds on the average *in the present sample of observations.*

In view of this relationship it is important to examine whether the shock was given consistently later with one drug than with the other. Using weighted differences between the mean times of shock with the two drugs (thiamylal minus thiopentone) in each patient the mean difference is found to be 1.12 second. That is, when thiamylal was used, the shock was given 1.12 seconds later on the average than when thiopentone was used. Therefore it is to be expected that the patients would wake $1.12 \times 5.8 = 6.5$ seconds later after thiamylal.

Thus of the 23.7 seconds by which the patients slept longer after thiamylal, 6.5 seconds can be accounted for the the later administration of the shock on those occasions, leaving only 18.2 seconds due to some difference between the drugs or to chance. This gives a value of $t = 1.49$ with 15 degrees of freedom which is no more than slightly suggestive, that there is a difference between the two drugs ($P = 0.16$).

Thus although in these experiments patients slept longer on the average after thiamylal than after thiopentone, part of

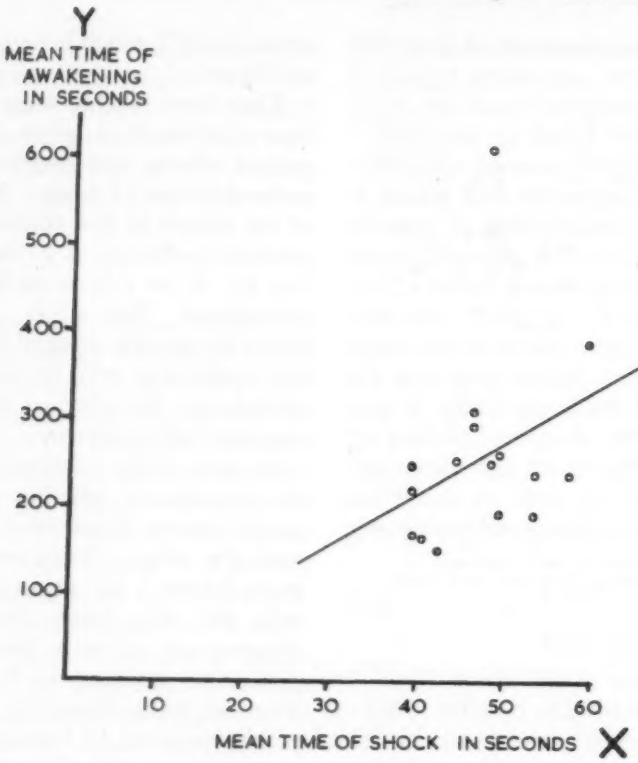


FIG. 4

the difference can be explained by the consistently later shock with thiamylal, while the remainder is only slightly suggestive of a real difference between the two drugs.

CONCLUSION

The data derived from these observations do not show any significant difference in potency between thiamylal and thiopentone, though they are suggestive that the former is slightly more potent. This difference, if present, might become significant with a larger series.

As a barbiturate before electroconvulsion therapy thiamylal appears to be as satisfactory as thiopentone and can be regarded as a satisfactory alternative or substitute for the latter drug.

Supplies of Thioseconal were kindly provided by Messrs. Eli Lilly & Co. Ltd.

REFERENCES

Bryce-Smith, R., and Hingson, R. A. (1954). *Anesthesiology*, **15**, 347.
Dillon, J. B., and Denson, J. S. (1950). *Ann. west. Med. Surg.*, **4**, 172.
Dornette, W. H. L., and Tuohy, E. B. (1951). *Curr. Res. Anesth.*, **30**, 159.
Helrich, M., Pepper, E. M., and Rovenstine, E. A. (1950). *Anesthesiology*, **11**, 33.
Kirchoff, A. C. (1951). *West. J. Surg.*, **59**, 90.
Lund, P. C. (1954). *Curr. Res. Anesth.*, **33**, 86.
Woods, L. A., Wyngaarden, J. B., Rennick, B., and Seevers, M. H. (1949). *J. Pharmacol.*, **95**, 328.
Wyngaarden, J. B., Woods, L. A., Ridley, R., and Seevers, M. H. (1949). *J. Pharmacol.*, **95**, 322.

Brit. J. Anaesth. (1955), **27**, 381

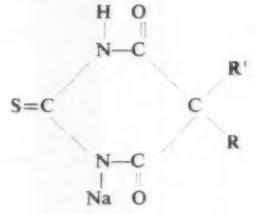
A CLINICAL TRIAL OF THIAMYLAL AS AN INTRAVENOUS ANAESTHETIC IN 1,750 CASES

BY

JOHN W. DUNDEE AND J. E. RIDING

Department of Anaesthesia, University of Liverpool

THIAMYLAL is one of the group of rapidly-acting thiobarbiturates which was described by Tabern and Volwiler in 1935. It bears the same chemical relationship to quinalbarbitone (Seconal) as thiopentone bears to pentobarbitone (Nembutal). The chemical structure of the two drugs is shown below:



	R	R'
Thiopentone	$-CH(CH_3)-C_3H_7$	$-CH_2.CH_3$
Thiamylal	$-CH(CH_3)-C_3H_7$	$-CH_2.CH=CH_2$

It can be seen that thiamylal is the sodium salt of 5-allyl-5′-(1-methyl butyl) -2 thiobarbituric acid.

Dornette (1954) has reviewed the development of the drug, the pharmacological properties of which were first investigated by Wyngaarden, Woods, Ridley and Seevers in 1949. Its use in clinical anaesthesia has been the subject of numerous American reports within the last five years, the most extensive being that of Lund (1954), whose experience at that time extended to more than 15,000 cases. Thiamylal is not commercially available in this country and the only report of its use is that of Barran and Wylie who described a small series of cases in which the drug was referred to as thioquinalbarbitone.

From the published reports it appears that thiamylal offers certain advantages over thiopentone which warrant further study. Over a period of about one year thiamylal was used by the authors as a routine drug in place of thiopentone, the precautions applicable to the latter drug being observed. This paper is a report of its use in 1,750 cases.

CLINICAL MATERIAL

Table I shows the nature of the operations for which thiamylal was used. The ages of the patients and the duration of the procedures are given in figures 1 and 2. The use of thiamylal as a main narcotic refers to its use as sole agent or combined with nitrous oxide and in some cases with an intravenous analgesic. It will be seen that the drug has been used in most types of operative procedures. In the age group 0–10 years there are few patients because the authors have few opportunities to anaesthetize children. Its rectal use as a basal narcotic has not been studied.

TABLE I

Nature of Operations.

Nature of operation	Thiamylal as main narcotic	Thiamylal for induction only	Total
Abdominal surgery			
Herniae	73	10	83
Gall bladder and pancreas	15	1	16
Gastric	51	3	54
Appendix	51	10	61
Prostate	20	1	21
Colon and Rectum	13	5	18
Renal	8	1	9
Miscellaneous	14	2	16
Thoracic surgery			
Thoracoplasty	21	0	21
Lung resections	46	0	46
Miscellaneous	20	0	20
Gynaecology			
Major	32	15	47
Minor	11	175	186
Neurosurgery	13	23	36
Orthopaedics			
Major	0	28	28
Minor	30	96	126
Endoscopy			
Bronchoscopy	104	0	104
Cystoscopy	86	58	144
Oesophagoscopy	20	0	20
Electroconvulsive therapy	307	0	307
Sympathetic nervous system	9	2	11
Thyroidectomy	0	11	11
Caesarean section	19	2	21
Intra-oral and Dental	9	9	18
Ophthalmic	0	5	5
Minor rectal surgery	20	41	61
Miscellaneous			
Varicose veins	33	30	63
Testes and scrotum	4	21	25
Breasts	2	23	25
Spine and back	11	8	19
Bladder and penis	2	7	9
Others	58	61	119
Total	1102	648	1750

TABLE II

Anaesthetic combinations.

A. Thiamylal as main narcotic combined with:	
Suxamethonium and oxygen	399
N_2O—O_2 long acting relaxant	302
N_2O—O_2	142
Used as sole agent	98
N_2O—O_2—analgesic ± relaxant	66
N_2O—O_2—suxamethonium	53
Gallamine triethiodide and oxygen	30
Spinal analgesic	12
Total	1102
B. Thiamylal for induction of anaesthesia followed by:	
N_2O—O_2—trichlorethylene	305
N_2O—O_2—ether	152
Cyclopropane and oxygen	84
N_2O—O_2—trichlorethylene ± analgesic	73
N_2O—O_2—ether—relaxant	30
Cyclopropane—oxygen—relaxant	4
Total	648

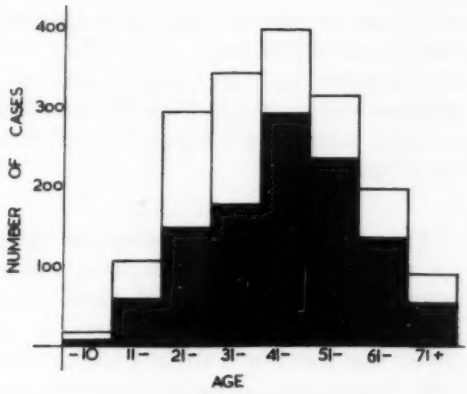


FIG. 1

Age distribution of cases

■ Thiamylal as sole narcotic.

□ Thiamylal for induction of anaesthesia only.

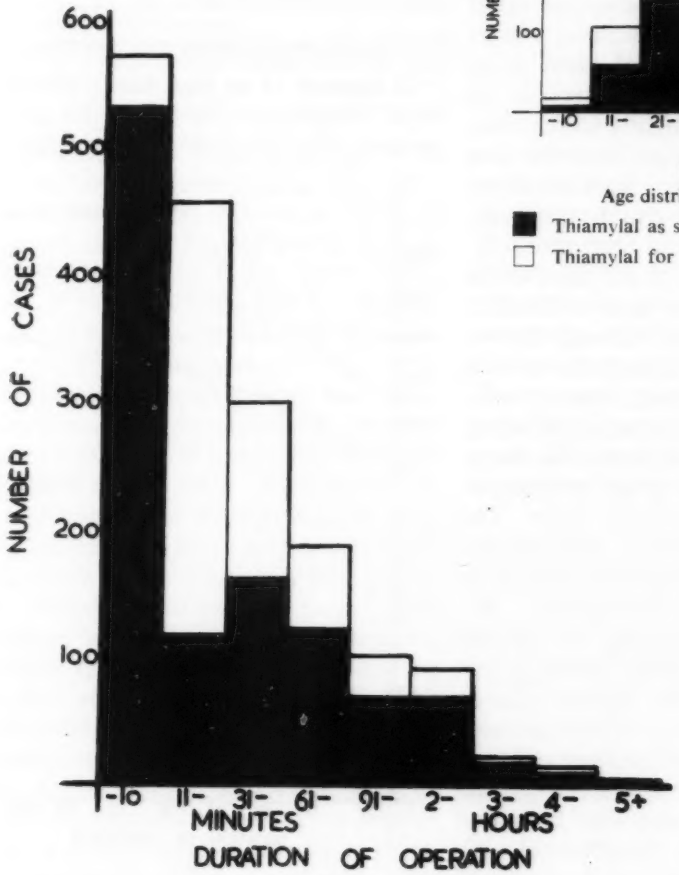


FIG. 2

Duration of operations

■ Thiamylal as sole narcotic.

□ Thiamylal for induction of anaesthesia only.

Table II lists the anaesthetic combinations with which thiamylal has been used, and it can be seen that this includes most recognized techniques. The drug was administered in a 2–5 and 5 per cent solution and in 40 cases (to be described in detail later) in a 0.4 per cent continuous drip.

CLINICAL RESULTS

Thiamylal is a rapidly effective agent for the induction of anaesthesia, which, from the patient's point of view, is as pleasant as thiopentone. There is no doubt that the drug is slightly more potent than thiopentone, as judged from the dose required to induce sleep. Supplementary agents were introduced with the same ease as after thiopentone, and respiratory depression seemed to be of the same order as that seen with other thiobarbiturates. No case of laryngospasm was seen following the induction of anaesthesia and no case of prolonged apnoea was encountered, attributable to the use of the drug. Comments cannot be offered on its tissue-irritant properties as gross extravenous injection did not occur in this series. The impression was gained that, with equipotent doses, recovery was more rapid from thiamylal than from thiopentone. Because of the multiplicity of factors involved in postanaesthetic vomiting, this was not studied. This applies also to postoperative respiratory complications.

In cases where blood pressure readings were taken during operation, the changes were similar to those seen after the use of comparable doses of thiopentone. No prolonged hypotension was encountered for which thiamylal could be held responsible. In 17 patients electrocardiographic studies during the induction and maintenance of anaesthesia showed no abnormality.

In our experience all the variations in response to thiopentone which are seen in certain pathological states such as shock and uraemia apply equally to thiamylal. A marked degree of resistance was encountered in only one patient, and this person had an acquired tolerance to opiates and similar drugs.

COMPARISON WITH THIOPENTONE

It appears to us that thiamylal differs from thiopentone mainly in its greater potency (fig. 3) and shorter action of

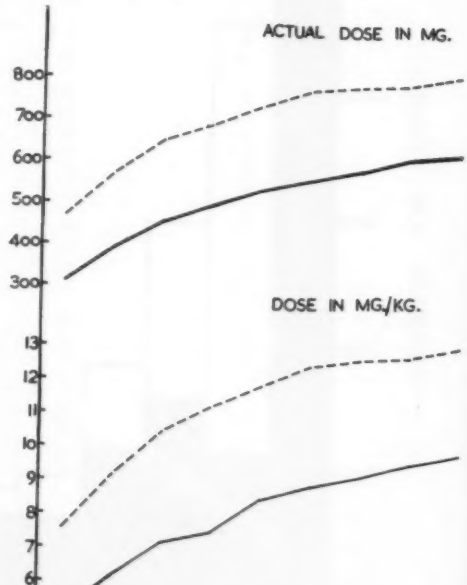


FIG. 3

Average doses of thiopentone and thiamylal required to produce anaesthesia in two comparable series of abdominal cases, in which the anaesthetic technique thiobarbiturate-relaxant-nitrous oxide-oxygen was used

- - - Thiopentone. —— Thiamylal.

TABLE III

Details of cases in which the requirements of thiopentone and thiamylal were analysed in detail.

	Thiopentone	Thiamylal
Number of cases	40	40
Average age (years)	45.1 ± 2.1	43.9 ± 2.2
Average weight (kg)	64.3 ± 0.97	66.8 ± 1.64
Sex incidence		
Males	28	27
Females	12	13
Nature of operations		
Varicose vein ligation	23	23
Urethral endoscopy	7	7
Prostatectomy (supplementary to spinal analgesia)	6	6
Transurethral prostatectomy	2	2
Pelvic floor repair (supplementary to local analgesia)	1	1
Bilateral inguinal hernia (supplementary to local analgesia)	1	1

equipotent doses. There also seems to be less tendency to laryngospasm than after thiopentone. These differences were first noted by Helrich, Papper and Rovenstine (1950) and later by Lund (1951, 1954), Wall (1951) and Philips (1953). Experimental studies in animals by Wyngaarden *et al* (1949) and Swanson and Chen (1953) have shown thiamylal to have less cumulative action than thiopentone on repeated administration. Wyngaarden and his colleagues have also established the greater potency of thiamylal in the dog.

It was decided to investigate in detail the problem of the duration of thiopentone and thiamylal narcosis in man. Two comparable series of patients, undergoing the same types of operation performed by the same surgeons were anaesthetized by continuous administration of 0.4 per cent thiopentone or thiamylal as the sole narcotic (table III). The average dose of each drug required to produce a similar depth of anaesthesia was calculated every 5 minutes and is shown in table IV. The depth was the lightest possible sufficient to obtund reflex and muscular response to surgical stimuli. In table V these results are expressed as mg/kg and reveal that, on the average, a significantly larger dose of thiopentone was required during the first 45 minutes of anaesthesia. The failure to find a statistically significant difference between the total doses of the two drugs at 60 minutes is in agreement with the hypothesis that thiamylal has a shorter action than thiopentone. The more cumulative agent (thiopentone) will require less incrementation than the less cumulative thiamylal.

TABLE IV

Comparison of average actual requirements of thiopentone and thiamylal.

Time	Average dose mg		S.E. (difference)
	Thiopentone	Thiamylal	
Induction	490 ± 36.7	363 ± 98.9	± 105
5 mins.	599	504	
10 mins.	697	592	
15 mins.	764 ± 19.1	699 ± 119.1	± 120
20 mins.	817	703	
25 mins.	879	770	
30 mins.	920 ± 36.8	816 ± 133.9	± 139
35 mins.	966	861	
40 mins.	1000	893	
45 mins.	1042 ± 26.2	921 ± 153.0	± 155
50 mins.	1073	969	
55 mins.	1095	990	
60 mins.	1109 ± 19.1	1013 ± 147.0	± 148

As a comparison between the cumulative action of the two drugs the supplementary doses required during fifteen-minute periods was compared (table VI). In this case allowance has to be made for the greater potency of thiamylal and doses of the latter were multiplied by a "correction factor". This was obtained by dividing the initial dose of thiopentone (mg/kg) by the initial dose of thiamylal (mg/kg). In three out of the four periods in which the supplementary dosage of the two drugs is compared on the above basis, a statistically significant difference was obtained.

Since it has been shown by Brodie (1952) that acute tolerance occurs to thiobarbiturates, and that the requirements during anaesthesia bear some relationship to the initial dose, in table VII the ratio of the total dose to the induction dose was compared at 5-minute intervals for each drug. This shows that the incrementation required to maintain a constant level of narcosis with thiamylal was significantly greater than that required for thiopentone. This clearly indicates that in these cases recovery after thiamylal was more rapid than after equipotent doses of thiopentone.

TABLE V

Comparison of average doses of thiopentone and thiamylal in mg/kg

	Average dose mg/kg		S.E. (difference)
	Thiopentone	Thiamylal	
Induction	7.70 ± 0.31	5.59 ± 0.23	0.441*
5 mins.	9.14	7.70	
10 mins.	10.77	9.06	
15 mins.	11.76 ± 0.36	10.27 ± 0.44	0.634*
20 mins.	12.54	11.12	
25 mins.	13.48	11.75	
30 mins.	14.11 ± 0.44	12.46 ± 0.45	0.822*
35 mins.	14.79	13.16	
40 mins.	15.30	13.67	
45 mins.	15.87 ± 0.47	14.15 ± 0.54	0.798*
50 mins.	16.32	14.72	
55 mins.	16.62	15.21	
60 mins.	16.81 ± 0.52	15.31 ± 0.68	0.962

*Represents a statistically significant difference between the doses of the two drugs

TABLE VI

Difference between supplementary doses of thiopentone and thiamylal in mg/kg required every 15 minutes.

Time interval (mins.)	Thiopentone (mg/kg)	Thiamylal (mg/kg)		S.E.† (difference)
		Actual dose	Corrected dose*	
1–15	4.06 ± 0.302	4.68	6.11 ± 0.394	0.496‡
16–30	2.35 ± 0.097	2.18	2.84 ± 0.233	0.243‡
31–45	1.76 ± 0.169	1.70	2.22 ± 0.180	0.247
46–60	0.94 + 0.005	1.16	1.51 + 0.190	0.190‡

* Corrected dose = actual dose × 1.305.

† Difference was calculated between actual dose of thiopentone and correlated dose of thiamylal.

‡ Represents significant difference between two drugs.

TABLE VII

Comparison of the average ratio of total dose of thiopentone and thiamylal administered at times shown to the induction dose.

	Ratio of total dose administered to induction dose		S.E. (difference)
	Thiopentone	Thiamylal	
0 mins.	1.0	1.0	
5 mins.	1.22	1.39	
10 mins.	1.42	1.64	
15 mins.	1.56 ± 0.051	1.84 ± 0.110	0.141*
20 mins.	1.67	1.94	
25 mins.	1.79	2.12	
30 mins.	1.88 ± 0.093	2.25 ± 0.083	0.134*
35 mins.	1.97	2.37	
40 mins.	2.04	2.46	
45 mins.	2.13 ± 0.107	2.54 ± 0.178	0.199*
50 mins.	2.19	2.67	
55 mins.	2.23	2.73	
60 mins.	2.26 ± 0.124	2.79 ± 0.163	0.125*

* Signifies a statistically significant difference between the ratio for the two drugs.

SUMMARY

On the basis of its use in 1,750 cases we believe that thiamylal is a safe intravenous anaesthetic, in many respects similar to thiopentone, but of slightly greater potency and with less tendency to cumulation.

ACKNOWLEDGMENTS

We are indebted to Dr. Robert Hodgkinson of the Department of Clinical Research, Parke Davis & Company, for generous supplies of thiamylal (Surital) and for his help during this clinical trial.

REFERENCES

Barran, D. A. N., and Wylie, W. D. (1951). *Anaesthesia*, **6**, 202.
Brodie, B. B. (1952). *Fed. Proc.*, **11**, 632.
Dornette, W. H. L. (1954). *Curr. Res. Anaesth.*, **33**, 38.
Helrich, M., Papper, E. M., and Rovenstine, E. A. (1950). *Anesthesiology*, **11**, 33.
Lund, P. C. (1951). *Amer. J. Surg.*, **81**, 637.
—— (1954). *Curr. Res. Anaesth.*, **33**, 86.
Philips, H. S. (1953). *Curr. Res. Anaesth.*, **32**, 56.
Swanson, E. E., and Chen, K. K. (1953). *Proc. Soc. exp. Biol. (N.Y.)*, **82**, 212.
Tabern, D. L., and Volwiler, E. H. (1935). *J. Amer. chem. Soc.*, **57**, 1961.
Wall, R. L. (1951). *N. C. med. J.*, **12**, 505.
Wyngaarden, J. B., Woods, L. A., Ridley, R., and Seevers, M. H. (1949). *J. Pharmacol.*, **95**, 322.

Dr. I. W. MAGILL

It is a source of much pride to all anaesthetists that Dr. I. W. Magill, who has had a most distinguished career and has made valuable contributions to both the art and science of anaesthesia, has been honoured by the Royal Society of Medicine. The Diploma of Honorary Fellowship of the Society was presented to him at a small informal ceremony on Thursday, July 14, 1955. Not only do we heartily congratulate Dr. Magill on having received a richly deserved honour, but we are very gratified to feel that this recognition of the work of one of our leading anaesthetists shows an understanding appreciation of the increased status of the specialty.

Brit. J. Anaesth. (1955), **27**, 388

ANAESTHETIC MANAGEMENT FOR REPAIR OF OESOPHAGEAL ATRESIA IN THE NEW BORN

BY

J. P. PAYNE

Postgraduate Medical School of London

ALTHOUGH the condition of atresia of the oesophagus has been recognized since the seventeenth century (Franklin, 1948) it was not until 1913 that the first attempt at relief by direct anastomosis was undertaken by Richter and it was a further thirty years before the first successful anastomosis was reported (Haight and Townsley, 1943). During the last decade the literature on the surgical management of oesophageal atresia has increased considerably but references to the anaesthetic techniques are still very few. In the United States Haight and Townsley (1943) have mentioned the use of open drop ether and Gross and Scott (1946) have recommended cyclopropane in a closed circuit without intubation, while, in South Africa, Roberts (1950) has described the anaesthesia he employed in a series of six patients. In this country Wilton (1951) has published the only detailed account of the management of anaesthesia for oesophageal atresia although Dinsdale (1954) has given a brief description of his method.

METHOD

Several days may elapse before a diagnosis of atresia of the oesophagus is made. Once it has been established, however, operation is undertaken without undue delay. In practice, this has meant that these young patients have come to the operating theatre within twelve hours of their admission to hospital. Before operation the child is nursed in a slight head down position and frequent suction is employed to keep the oral and nasal passages free from mucus. As a further precaution an intravenous drip of 1/5 N saline is established by the insertion of a fine polythene catheter into the medial saphenous vein over the medial malleolus. Atropine 1/200 grain (0.3 mg) is given intramuscularly thirty minutes before the operation is due to begin.

Anaesthesia is induced with intravenous thiopentone given slowly into the drip; a dose of 2.5–5 mg/lb (0.45 kg) of body weight in a 2.5 per cent solution is usually employed. This is followed by d-tubocurarine chloride 1 mg/5 lb (2.25 kg) of body weight. The pharynx and larynx are then cleared of secretions and the larynx intubated with a No. 00 armoured endotracheal tube. The latter is strapped in position and it is suggested that a soft pack or a dental sponge placed between the tongue and the hard palate will prevent movement. Respiration can then be readily controlled throughout the course of the operation. Controlled respiration is indicated because although

originally access to the oesophagus was obtained by the extrapleural route, today the transpleural approach is the one most commonly adopted. The assistance of completely controlled breathing facilitates greatly the surgical technique. Before the operation is begun the anaesthetist should pass a fine rubber catheter, preferably through the nose, into the upper end of the oesophagus. This manoeuvre helps the surgeon to localize more readily the tip of the upper segment.

When the incision is made, blood is substituted for the intravenous saline and allowed to drip slowly. Anaesthesia is maintained with a 50 per cent mixture of nitrous oxide and oxygen using a flow rate of 3–4 litres per minute through a Cope infant absorber. The inadvertent building up of pressure is avoided by having an opening in the catheter mount which can be sealed with the fingertip when required. Throughout the operation, at the end of each surgical manipulation, the retractors are removed and the lungs gently inflated.

If the baby still shows signs of curarisation at the end of operation neostigmine 0.03 mg per lb (0.45 kg) of body weight is given intravenously after a preliminary injection of atropine 1/200 grain (0.3 mg) When breathing is considered adequate the infant is returned to the ward in an oxygen tent.

RESULTS

Table I illustrates the main features of the patients in whom relief of an oesophageal atresia was undertaken during the latter half of 1954. It will be seen that of the six patients four are alive and well while two babies failed to survive. Both of these children had other congenital abnormalities.

Baby A. V. had previously been anaesthetized for the repair of an exomphalos but as far as was known she had no abnormality incompatible with life. Nevertheless, about 48 hours after operation she suddenly collapsed and died. The cause of death was never established as autopsy was refused.

Baby I. E. was a healthy child despite the congenital absence of his right arm. Induction and maintenance of anaesthesia were uneventful and he was breathing well when the endotracheal tube was removed. Immediately after withdrawing the tube, however, he appeared to be in some respiratory difficulty; he was consequently re-intubated and oxygen administered. There was no evidence of bronchial obstruction yet his colour became darker and he died within an hour of operation, apparently from asphyxia. At autopsy massive collapse of the right lung was found; it was further demonstrated that the normal pattern of lobes in the right lung was deficient. In retrospect it is almost certain that the collapse was due to a tension pneumothorax brought about by the combination of positive inflation of the lungs and a blocked drainage tube.

TABLE I

Patients with congenital atresia of the oesophagus
Results of operation.

Patient	Sex	Age	Birth weight		Other abnormalities	Survival
		hours	lb	oz		
A.R.	F	34	8	2		Alive and well
R.R.	M	72	5	5	Deformity right ear with accessory auricles	Alive and well
J.B.	F	20	4	4		Alive and well
A.V.	F	56	5	0	Exomphalos	Died 48 hours after operation
R.T.	F	56	5	3		Alive and well
I.E.	M	31	4	4	Absence right arm	Died one hour after operation

COMMENT

Fundamentally the anaesthetist's responsibility in the management of anaesthesia for the repair of atresia is threefold: (1) the provision of adequate anaesthesia and relaxation; (2) the prevention of anoxia and the elimination of carbon dioxide; (3) the replacement of blood loss and the restoration of disturbed fluid balance.

The hypnotic effect of thiopentone combined with the analgesic properties of nitrous oxide provide the required anaesthesia without undue depression. The provision of adequate relaxation for the surgeon is a most important feature of the management of these small patients. Breathing during the neonatal period of life is essentially diaphragmatic and abdominal, and this tends to put a variable degree of strain on the lower segment of the oesophagus. One of the dangers of operating under local anaesthesia is the tension placed on the sutures by coughing and straining. The use of a relaxant eliminates all tension and allows the surgeon to make his anastomosis deliberately and without hurry, thus reducing greatly the risk of sutures cutting out.

Although infants in the neonatal phase are remarkably tolerant of degrees of hypoxia which in the adult would produce irreversible changes, this is no justification for the mismanagement of their oxygen supply. The average new-born child requires about 25 ml of oxygen per minute (Smith, 1951) and as such a baby has a tidal air of approximately 20 ml (Deming and Hanner, 1936) a fairly rapid respiratory rate is needed to supply the necessary oxygen. This rate may be 40/min. When the chest is opened the tidal air is even further reduced and measures must be taken to ensure an adequate oxygen supply. The high oxygen content of the inspired gases contributes to satisfactory oxygenation. Breathing is further assisted by the removal of retractors at intervals throughout the operation to allow the collapsed segments of lung to be re-inflated. Patches of atelectasis are encouraged to expand by gentle massage with the tip of the operator's finger.

In babies with oesophageal atresia a further embarrassment to respiration is offered by the presence of a tracheo-oesophageal fistula in 80 per cent (Franklin, 1948). In these patients, when controlled respiration is carried out distension of the stomach and intestines may follow. This can be avoided to a great extent by the surgeon closing the fistula as soon as possible after the chest is opened.

Any notable reduction in minute volume must lead to carbon-dioxide retention and it seems likely that many of the deaths reported following anaesthesia in young infants are due to this cause. The toxic manifestations of carbon dioxide are often masked during anaesthesia particularly when the patient is well oxygenated, and a narcotic concentration may be built up insidiously. Donald and Paton (1955) have pointed out that all anaesthetics and narcotics when given in larger doses finally cause medullary failure and they have commented that there is no reason to believe that carbon dioxide is any exception. Furthermore it has been shown (Bell *et al.*, 1928) that in neonatal life a metabolic acidosis exists

which may be regarded as physiological. If however a superimposed respiratory acidosis is added, this benign state may be converted into a lethal one.

The elimination of carbon dioxide is assisted by a high rate of gas flow, adequate controlled ventilation and the use of an absorber. Depressant gases such as cyclopropane and chloroform are best avoided.

Blood loss is not usually excessive in the repair of oesophageal atresia particularly if rib resection is avoided. Nevertheless when it is considered that the average 7 lb (3 kg) baby has a total circulating blood volume of approximately 270 ml (Mollison *et al.*, 1950) it will be recognized that even slight haemorrhage needs replacement. In most cases 30–60 ml of blood are sufficient but occasionally 100 ml or more are required. Belsey and Donnison (1950) recommend the use of 200–300 ml of blood but their technique involves rib resection with presumably considerably more blood loss.

The amount of fluids administered will naturally depend on the degree of dehydration. If the child is only a few hours old dehydration will not be present. If however, several days have elapsed since birth it is advisable to establish a fluid intake. 1/5 N saline should be given but care must be taken to guard against over-transfusion. 10–15 ml of fluid per lb per day is adequate (Smith, 1951). Under-transfusion is undoubtedly safer than over-dosage and indeed complete starvation for the first 72 hours is a standard practice in the routine management of new-born premature babies. In infants, where evidence of dehydration is absent 5 per cent glucose intravenously is probably safer than 1/5 N saline.

No matter how well the surgical and anaesthetic techniques are developed there will be few successful results without the very highest standard of nursing care during the immediate postoperative period. The ultimate result is, in fact, absolutely dependent on the care and vigilance of the nursing staff.

Finally it may be said that the only chance of survival given to these small patients is operative repair. Surgical intervention is, however, dependent on the early recognition of the anomaly and as Franklin (1948) has pointed out, it cannot be emphasized too often the great responsibility resting on midwives and paediatricians to exclude atresia of the oesophagus in all new born infants who suffer from attacks of cyanosis and choking.

Morris and Heady (1955) have demonstrated that the decline in neonatal mortality has not kept pace with the fall during the remainder of the first year of life. They attribute this, among other things, to congenital malformations and mechanisms leading to "asphyxia" and "atelectasis". If as Belsey and Donnison (1950) claim the incidence of atresia of the oesophagus is 1 in 800 births, the early diagnosis and treatment of these unfortunate infants ought to reduce the incidence of neonatal deaths.

SUMMARY

The management of anaesthesia for the repair of congenital atresia of the oesophagus is described.

A short series of six cases is presented.

The problem of anaesthesia in such

cases is discussed and certain dangers emphasized.

ACKNOWLEDGMENTS

I am indebted to Mr. R. H. Franklin for the opportunity to anaesthetize these small babies and in particular I would like to thank him for permission to give the details in table I from his unpublished series.

REFERENCES

Bell, W. B., Cunningham, L., Jowett, M. Millet, H., and Brooks, J. (1928). *Brit. med. J.*, **1**, 126.
Belsey, R. H. R., and Donnison, C. P. (1950). *Brit. med. J.*, **2**, 324.
Deming, J., and Hanner, J. P. (1936). *Amer. J. Dis. Child.*, **51**, 823.
Dinsdale, T. (1954). *Anaesthesia*, **9**, 206.
Donald, K. W., and Paton, W. D. M. (1955). *Brit. med. J.*, **1**, 313.
Franklin, R. H. (1948). *Ann. roy. Coll. Surg. Engl.*, **2**, 69.
Gross, R. E., and Scott, H. W. (1946). *Surg. Gynec. Obstet.*, **82**, 518.
Haight, C., and Townsley, H. A. (1943). *Surg. Gynec. Obstet.*, **76**, 672.
Mollison, P. L., Veall, N., and Cutbush, Marie (1950). *Arch. Dis. Childh.*, **25**, 242.
Morris, J. N., and Heady, J. A. (1955). *Lancet*, **1**, 343.
Roberts, F. W. (1950). *S. Afr. med. J.*, **24**, 167.
Smith, C. A. (1951). *The Physiology of the New Born Infant*, 2nd ed., pp. 155 and 291, London: Blackwell.
Wilton, T. N. P. (1951). *Anaesthesia*, **6**, 30.

Brit. J. Anaesth. (1955), **27**, 393

PETHIDINE AND GALLAMINE ALONE IN THE TREATMENT OF FRACTURED MANDIBLE

BY

DAVID L. SCOTT

County Hospital, Sundsvall, Sweden

USUAL ANAESTHETIC TECHNIQUE

THE usually recognized technique of anaesthesia for reduction of a fractured mandible involves nasal intubation (Boyd and MacLennan, 1952), and in war injuries, which are usually of a more complicated nature, this is essential (Roche, 1945).

While realizing the safety of such a technique, I feel that it still has definite disadvantages and risks, which are given below:

Passage of a nasal tube. This can cause bleeding, particularly if the anaesthetist is unskilled. Should this bleeding be excessive, it can run down into the stomach and may possibly cause postoperative vomiting (Hewer, 1953). As the postoperative end-result will be a tightly closed mouth; there is no oral "escape route" should the nasal one prove too difficult.

Technical difficulties in nasal intubation. Two techniques are recognized:

(i) Direct vision—using laryngoscope and Magill forceps. This can be extremely difficult. If acrylic splints are already in position, the oral access may be minimal, and they must not be displaced. Furthermore, possible narrowing of the angle of the mandibular body or its displacement backwards can increase intubation difficulties.

(ii) Blind nasal intubation. Prior to the relaxants this was the method of choice for most anaesthetists. Today there can be few who are experts in this technique, and James' view (1950) is surely shared by many. Inexpert blind intubation is more likely to lead to both nasal bleeding and even more severe trauma (Coffin, 1950; Brown, 1952).

Cranmer (1955) suggests a technique of blind intubation using thiopentone and suxamethonium. This surely needs practice, and in many parts of the world the human skill is just lacking.

Postoperative vomiting. Apart from vomiting of blood that has run down into the stomach, this is more likely following a general anaesthetic than after an non-anaesthetic technique. Hypoxia (Clement, 1951) will further increase this hazard (e.g. occurring during a difficult intubation). Vomiting occurring in a patient in whom the mandible has been securely fixed to the maxilla must be considered as very dangerous—even where there is perfect postoperative attention and the necessary wire cutter to hand.

Although not dangerous, postoperative retching can disturb the result.

From the above-mentioned complications it may be concluded that general anaesthesia in such cases is not always ideal. Correct local analgesia can some-

times be very difficult and relaxation is often unsatisfactory.

NEW APPROACH TO THE PROBLEM

In June 1954 I had to anaesthetize a man with a fractured mandible, and attempted direct vision nasal intubation, but could only pass a No. 5 Magill tube through either nostril. This caused moderate haemorrhage and I felt that this tube was too small for the maintenance of anaesthesia—even for a short period. The operation was postponed, and this experience led me to develop the following technique.

The requirements for reduction of a fractured mandible are (in common with many procedures):

(i) Adequate relief from pain, i.e. analgesia.

(ii) Muscular relaxation.

The principle was to use morphine and pethidine for the former effect and gallamine triethiodide (Flaxedil) for the latter —but NO anaesthetic.

I have used this technique five times on four male patients, aged 19 to 41 years. The dates were June, July, October, and December 1954. I fear that it would take too long to get an adequate series, so have felt justified in communicating the idea so that others with greater access to these cases can possibly try it out—and improve further on it.

Technique.

It should be noted that each case led to some alteration in technique—thus only the method in the last case is described.

Premedication. Morphine 1/6 to 1/4 grain (10 to 15 mg) and atropine 1/100 grain (0.65 mg), one hour before operation. As the patients are unable to swallow during the procedure, a dry mouth is desirable.

Explanation to the patient. This is most important, as it is essential to gain his confidence yet not frighten him. All four patients were placid.

The patients were told that this was not an anaesthetic—but that they would feel sleepy, and that one of the drugs would greatly diminish pain, but that they might still feel the actual reduction of the fracture a little. It was explained that the other injection would cause the jaw, limb and neck muscles to relax. It might affect the breathing, but that if they were uncomfortable there was no danger and that oxygen and the antidote were ready.

It is essential to have an agreed signal about the respiration, as speech is virtually impossible. A suitable system is for the patient to raise one hand if breathing becomes difficult, and the other if he feels that it is very difficult or might stop. It actually did stop in the second case. If in doubt as to the patient's memory, this signal can be written down on paper.

Dosage and administration. An Olovson (commonly known as "Gordh") needle was used. I began by injecting 50 mg pethidine (1 per cent solution) slowly intravenously. After a pause to see if there was any nausea, a further 25 or 50 mg was given—depending on the size of the patient and the effect of the morphine.

An initial dose of 20 mg gallamine was then given, and its effect judged as in normal anaesthetic practice. Further doses of gallamine were given at intervals of 1½ to 2 minutes as follows:

Second dose, 20 mg.

Third dose, 10 mg, and similar subse-

FIG. 1

quent doses. 60–80 mg gallamine were required, and after the experience of the second case a "head raising" test was devised, in which the patient was asked to raise his head prior to giving each succeeding dose of gallamine. When he can no longer raise it, relaxation of the jaw should be adequate—and so should the respiration.

More pethidine was given, usually in 25 mg doses as required according to the amount of pain, and a nod or shake of the head can supply the answer to enquiries in the absence of speech. The maximum dose of pethidine used was 200 mg, and it seemed that 150 mg should be adequate for the average male. As with gallamine, there must be a pause before the drug begins to take effect, which is time consuming but essential. In practice these drugs may well be given alternately and the respective effects noted.

Atropine and neostigmine were given in the usual way when the dental surgeon had completed the procedure.

Precautions. It need hardly be said said that oxygen, a face-mask and bag, and a syringe *already filled* with prostig-

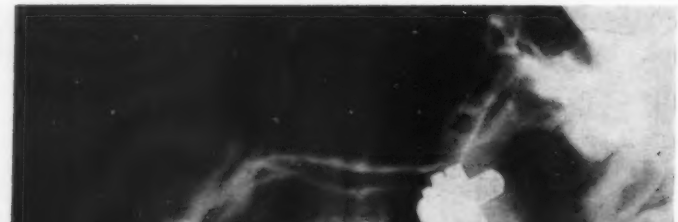


FIG. 2

mine must be at hand. The Olovson needle is essential if a quick injection of neostigmine is required.

TYPES OF OPERATION

In the first three cases the mandible was wired to the maxilla using acrylic splints. The second case was interesting in that he had a fractured mandible (in three places), maxilla and nose—a difficult intubation problem.

Figure 1 shows the last case; pin fixation was performed. Local was used for the insertion of the pins and the radiological result is shown in figure 2. It is not perfect, but it gives an idea of the amount of work possible with this technique.

RESULTS

These are difficult to assess from so few cases:

(i) From the dental surgeon's viewpoint his operating conditions were quite satisfactory.

(ii) From the patient's viewpoint (four placid men!), it did not seem so bad in practice as one would think from reading the foregoing. My main query was as to the amount of pain felt. Their answer was: "I felt a little—but that was nothing." The last patient—who had the biggest procedure—was operated on on two successive days; he did not seem perturbed at the thought of his second operation.

COMMENTS

I cannot describe this procedure as pleasant—indeed, the entire treatment of fracture of the mandible must be very unpleasant. However, the doses of analgesic drugs used were fairly big and in

practice it "worked", the pain involved being only slight and momentary. Fortunately, fracture patients are, as a rule, co-operative, grateful for their treatment and otherwise fit.

Maybe there are special indications for this technique: (1) Nasal obstruction, polypi and especially a broken nose. (2) Lack of oral access (i.e. a technically difficult intubation). (3) Placid and intelligent patients. (4) Absence of an anaesthetist skilled in intubation. (5) Preference on the part of the dental surgeon (or patient) for "local"—a very marked feature in Sweden, for example.

Apart from these indications—it seems to avoid certain theoretical risks and difficulties. The "standard" technique must, however, be used in many cases of simple and all cases of complicated fractures (war injuries) of the mandible.

SUMMARY

A non-anaesthetic technique using pethidine and gallamine in the treatment of *simple* fractures of the mandible is described. This avoids the risks and difficulties of anaesthesia and nasal intubation in these cases.

The "series" is very limited, only four cases. Owing to lack of opportunity for further trial of the method, the author feels justified in writing up this technique as it seems to have promise, and maybe others with better opportunities may investigate its possibilities.

There must be great room for improvement, especially now that the phenothiazine derivatives are being used in anaesthesia, with their beneficial effect on vomiting and fear. Patients must, however, retain their faculties enough to react to depression of their respiration.

ACKNOWLEDGMENTS

I wish to thank Herr Gunnar Witkowsky, dental surgeon, for his co-operation in developing this technique; also Dr. Erik Evers for his permission to publish the roentgenograms.

REFERENCES

Boyd, W. H. F., and MacLennan, W. D. (1952). *Anaesthesia*, **7**, 24.

Brown, W. M. (1952). *Anaesthesia*, **7**, 118.

Clement, F. W. (1951). *Nitrous Oxide-Oxygen Anesthesia*, 3rd ed., p. 162, London: Kimpton.

Coffin, S. (1950). *Anaesthesia*, **5**, 104.

Cranmer, J. G. (1955). *Anaesthesia*, **10**, 86.

Hewer, C. L. (1953). *Recent Advances in Anaesthesia and Analgesia*, 7th ed., p. 388, London: Churchill.

James, N. R. (1950). *Anaesthesia*, **5**, 159.

Roche, G. K. T. (1945). *Brit. J. Anaesth.*, **19**, 141.

Brit. J. Anaesth. (1955), **27**, 398

HYPNOTISM AND THE ANAESTHETIST

BY

ANTHONY OWEN-FLOOD

Senior Anaesthetist, Hornsey Central Hospital, London, N.8

INTRODUCTION

Now that there is a renaissance of hypnotism in this brave new world of psychology it has become the habit to regard it as a weapon wielded solely by the psychologist. In its previous incarnation it was used mainly in the art of surgery, and as a means of avoiding the awful ordeal of pain attendant on the early surgical procedures. In other words it was the sole property of one who would now be called the anaesthetist, and since the main feature of hypnosis is "putting the patient to sleep" in order to avoid pain, who has a better claim to its use? Yet now, in modern times, it receives scant attention from the members of our faculty and, save in the matter of dental extractions, the subject is, in the main, ignored.

Hypnotism has always been regarded by the members of our profession generally as a somewhat exotic and slightly disreputable method of therapy, and those practising the art as mere "stunters". The anaesthetists, in company with the rest, can console themselves somewhat for this lack of interest. Hypnotism in its induction and practice does indeed *appear* to be somewhat exotic, and the impression of those viewing the phenomena for the first time is that the whole thing is just a clever trick. For this very reason stage representations are still so popular.

Du Maurier served hypnotism ill when he suggested to the public, in the novel *Trilby*, the Svengali-Trilby set-up of the master-mind over the simple weak will. This entirely false aspect of hypnosis is still believed by the general public, and by many members of our profession.

Many justifiable objections can be taken by the anaesthetist in hospital practice to hypnosis, and the methods used for its induction. By ordinary methods, it takes anything from half to one hour to induce hypnosis in the average patient, especially surrounded as he is by the somewhat macabre and frightening bustle of the average hospital ward. Add to this the lack of co-operation, if not open hostility of the staff, and the use of hypnosis grows less and less attractive.

HYPNOSIS IN RELATION TO THE ANAESTHETIST

What use can the anaesthetist make of hypnosis? The rapid strides made in the past century in anaesthesia are well known; it was the discovery of ether and nitrous oxide that sounded the death knell of hypnosis. For this reason then, as now, it was considered that narcotics producing anaesthesia were much simpler to administer, easier to control, and more certain in their effects. The administration of the present-day anaesthetic is a simple, if not

a delightful experience for the patient. It is not necessary to have him gazing at bright lights, or to monotonously stroke his forehead; just a slight prick of a needle and he awakes in bed with his operation over.

HYPNOSIS *versus* NARCOTICS

Though far inferior to anaesthesia in everyday use hypnosis can be used for general anaesthesia, for it can abolish the feeling of pain and relax the muscles. It does not prevent physical shock which is likely to appear as profound collapse after the patient has returned to his bed, when a timely injection of morphia may be required to ward off a disaster. So much then for the shortcomings of hypnosis: what of its virtues?

VIRTUES OF HYPNOSIS

Pain, its origin, varieties, intensities, and its thresholds, is ever in front of the anaesthetist, demanding his attention and study. We know that psychic tension plays a major role in the matter, lowering the threshold of pain appreciation. A comparatively minor toothache, unnoticed by the busy well-balanced man, can become a hell torture to the anxiety-ridden neurasthenic. Psychic tension is notoriously inconvenient to the anaesthetist, apart from the patient. A frightened, tensed, pre-operative patient needs more premedication, more anaesthetic narcotic, and is therefore a more restless postoperative case, necessitating increased postoperative sedation. It is true that pre-operative medication, and the use of thiopentone intravenously, does much to surmount these difficulties, but not altogether, for the more the psychic tension, the higher the metabolic rate and the operative risk.

RELIEF OF PRE- AND POSTOPERATIVE TENSION

We, intimately living, as we do, in a world of surgery, are prone to forget that we are seeing the prospective operation patient, only a day or two before the event, which, to him, is a dread psychological experience. Except in the mentally well-equipped, the event has been turned around and about in his subconscious mind probably for weeks. It has been considered and rationalized as to its inevitableness, until there is a large measure of resignation produced; but still, in the background, there will lurk the fear of death. Children, fortunately, are immune from this type of thinking, but nevertheless they do talk amongst themselves, and often are the horrific details of "what they do to you" in hospital told and retold by his siblings or school friends, who have themselves been in hospital; add to this the separation from the mother, the strange surroundings and faces, and you have an average pre-operative child. Using hypnosis as long as possible before the expected operation does a lot to dissipate these fears, and lower the psychic tension.

HYPNOSIS IN CHILDBIRTH

Nowhere is hypnosis seen to better advantage than in childbirth. Here, pain is greatly influenced by the heightened emotions. It has been well established that unstriped and, to a lesser degree, striped muscle is also influenced by this factor. The uterus in particular shares this with the rest of the body musculature.

So too does the levator ani. Anything causing disfunction of these important muscles of parturition, any factor altering the rhythm or causing spasm when they should be relaxing, will produce pain and eventually delay the course of the labour. The training of relaxation, given by competent teachers to the expectant mother, has proved very well worth while.

Similar instructions under hypnosis, and control under that influence at the actual time of labour, carries this method of muscle and psychic relaxation a step further, and allows the hypnotist to regulate the actions, at least of the levator ani and abdominals. In this way a perfectly painless labour is possible, the perineum is safeguarded and seldom is there delay in that most dangerous phase, the second stage. The above relates to normal cases, with no anatomical obstruction. Even in these, where there is mild disproportion of the pelvis and a "trial of labour" in the Walcher position is advised, relaxation under hypnosis is very helpful. This type of pain relief in childbirth is getting very popular, and women are demanding the services of a hypnotist. It is a pity this is invariably a physician and not an anaesthetist.

USE OF THIOPENTONE IN HYPNOSIS

For the anaesthetist really interested in hypnosis, it is recommended that he consult some of the leading works on the subject. He should then see the actual condition produced by an expert, *medically qualified*. Stage representations are of no scientific value whatever, and are, if anything, misleading to the inquirer. Having seen the phenomenon, he should himself experience the state of hypnosis. Then he is ready to practise, by ordinary methods, the induction of the state, either on patients or lay subjects. Having made himself proficient on these lines, he should concentrate on the method of hypnonarcosis using thiopentone.

METHODS

The use of thiopentone and the art of venepuncture in general is the daily practice of the anaesthetist. I chose this method for that reason. It is handy in its administration, produces all the stages of hypnosis from mild relaxation to somnambulism, and the anaesthetist is in control all the time, regulating lightness or depth at will. Another reason is that it is the speediest method of producing the phenomenon, an important factor in a busy hospital. Moreover, it is a simpler method and has no apparent "hoodoo" trappings, no passes or prolonged eye fixation, or continuous monotonous suggestions of sleep. It is positive in its action, and it works in 100 per cent of cases, all important factors in hospitals. It is easy, also, to continue the injection to complete anaesthesia if there is a question of operative procedure.

THE HYPNOTIC STAGE OF GENERAL ANAESTHESIA

It is worth while considering in detail this method of narco-hypnosis using thiopentone. All textbooks on anaesthesia describe a state seen in the early part of stage one of anaesthesia. It is a point when the patient lapses from the alert awake state to the slight dreamy, somewhat confused, condition which has been described in many anaesthetic books as *sleep*; the

breathing is slow and regular, if somewhat deep, reflexes are also slow, and sometimes absent. The patient is capable of responding to questions, replies are slow, but on the whole intelligent. Sleep this condition may be, but it is also light hypnosis. The stages are for all practical purposes identical. Natural sleep can, in good subjects, be turned into hypnosis by suggestion, without awakening the subject. This is an easy matter in the majority of children.

PRELIMINARY INSTRUCTIONS

Taking advantage of this hypnotic state, the patient is told by the anaesthetist that he is going to put him into a light state of sleep, when he will hear every word spoken by him, and will obey all instructions and suggestions given. This will be in no way a matter of forcing the condition, but the anaesthetist will be merely acting as his guide, and assisting him to reach this stage. He will tell him that he will be giving him a slight prick of a needle in his arm, which he will hardly feel. A signal is then given; any signal will do, such as "Then I will count three, and at the third number you will fall asleep" or "I will look at you and whistle". It must be a definite signal. I generally count with adults, or press my thumb on the bregma. With children I say, "I will blow on your face and then you will fall asleep." It is well to do this, as afterwards, if it is necessary to give an anaesthetic, blowing with nitrous oxide in a Boyle's serves just as well where it is impossible to venepuncture.

The patient, now understanding the procedure of induction, is instructed as to his awakening. "I will tap three times on your forehead, when you will awake feeling refreshed and well" or, if he is to have an operation, "You will awake from your operation in your own bed and feel well and free from pain". It is even possible to control excessive vomiting. These factors help considerably the nursing of the case.

TECHNIQUE OF THIOPENTONE INDUCTION

Placed on a comfortable couch or, if it is necessary, on a theatre trolley which is not so comfortable, the patient should be put in the quietest room in the hospital. There must be no tearing about of nurses with or without messages, no clattering of instruments or loud conversation, in fact just the atmosphere of monastic quiet which *should* but, alas, does not exist in the normal anaesthetist's annexe to the theatre. Distraction of this kind makes the induction of hypnosis impossible.

TECHNIQUE OF INJECTION

The thiopentone is now prepared and drawn into a 20-ml syringe. Unless it is intended to produce complete anaesthesia after induction of hypnosis, 0.5 g of the narcotic is sufficient, made up to a 2.5 per cent solution. Since the minutest amount of thiopentone is necessary to obtain the state, this dilution is easier to control. choosing a small size *sharp* hypodermic needle, all is now ready. The needle is inserted into a vein and the patient instructed to keep his eyes open. Inject just enough to produce that slight drowsiness already described. The pupils will dilate slightly and at the signal the eyes will close. Talk the patient down into hypnosis. "You are feeling comfortable and warm." "You are feeling a little

sleepy." Now give your signal: "You are now asleep but can hear my voice, your arm is rising above your head." He will raise his arm; but should he fail to do so raise it for him. "Now it is stiff like an iron rod, and you cannot put it to your side." These tests being positive, the patient will be in hypnosis and ready for the suggestions of the anaesthetist hypnotist.

SUBSEQUENT INDUCTION AT A GIVEN SIGNAL

It will not be necessary to inject thiopentone at the next sitting, for before awakening your patient you will give him the signal, and command that the next time you say it, he will fall asleep without the prick of the needle. This posthypnotic command will be obeyed. The art in the technique is to be able to estimate the minimum of the drug to produce the effect. Too much will, of course, spoil the effect by the patient passing into anaesthesia. One should remember, too, the variation in each individual of the exact circulation time. It is a good method to place the patient's arm, stiff in catalepsy, above his head at the early onset of hypnosis: if and when his arm falls flaccidly to the side, he has then passed from hypnosis into anaesthesia. A dainty estimation of dosage is particularly needed in dealing with the child.

HYPNO-NARCOSIS IN CHILDREN

A different method of approach may be necessary in dealing with children. In cases where it is impossible to do a venepuncture, it can be quite satisfactory to blow on nitrous oxide with the tube concealed in the palm of the hand. "I am a magician and I can blow you to sleep by blowing on your face" puts the relation of the hypnotist and patient on an immediate working basis, well understood by the mind of a child. "I am blowing on your face, and you feel as if you were in your own little bed and you are going to sleep." This method is also quite good in the ordinary induction of ethyl chloride for anaesthesia, where the narcotic is placed in a Boyle's and blown on with oxygen. Using this means when venepuncture is possible, the child is told that he will have a slight prick of a needle, but it will not hurt him, for before doing this you will rub in some magic ointment. A little nupercaine rubbed in with a lot of suggestion will accomplish this. The needle is then inserted and the procedure is the same as for an adult. The metabolic rate must be allowed for in judging the necessary dosage. With children a running "question and answer" technique gives a clue to the state, with its slightly slurring speech, which is a feature of the ordinary state of hypnosis.

RESULTS

Combining, as I do, general practice with my anaesthetic specialty, I have ample opportunity to test out the efficiency of this method of inducing hypnosis. Hypnosis does produce dramatic cessation of symptoms which may or may not be permanent. In the main, an analysis of the deep subconscious roots of the disease cannot, and indeed should not, be omitted. Hypnosis should be regarded as a convenient channel for the easy flow of the contents of the subconscious. I do confess that most of my failures, and I

have had many, have been due, not so much to the failure of hypnosis, but the neglect or the lack of opportunity to accomplish this.

I have mainly studied the following diseases, so most of my case histories concern these. Epilepsy, auto-erotism, somnambulism, and nocturnal enuresis. Many of these cases have been seen by me in hospital undergoing operation for other diseases, and I have been able to test out the use of hypnosis at a given signal.

Some cases are cited demonstrating methods using thiopentone, and others induced by the ordinary methods. A case of laparotomy using hypnosis is also given.

Epileptics, in general, dread the onset of unconsciousness. No patient with this disease enjoys the sensation of oncoming oblivion. They are, therefore, almost impossible to induce by the ordinary methods of hypnosis, and because of this have invariably been dubbed " poor subjects ". Once under the influence of the phenomenon they are excellent patients. To overcome this induction difficulty, caused me to first try the thiopentone method, and I found it was ideal in these cases. Taking routine doses of phenobarbital, sometimes much too heroic, sooner or later alters the personality of the individual, and cortical changes become evident. They are ordered to stop taking the drug, and I rely on the relaxant groups, such as epanutin, as a substitute.

Hypnosis cannot cure epilepsy, but the fits can be controlled by this means, so that they take place at night when the patient is safe in bed, and above all, they are robbed of their terrors, and by hypnotic suggestion the patient makes friends with his disease. This alteration of attitude does much to rehabilitate the patient, restore his self-confidence, and relieve him of the feeling that he is an outcast and a freak.

CASE HISTORIES

Epileptics.

J. L., female, age at time of first consultation 29 years. Fits since she was 10 years old several times a week with much tongue biting. Under fair control with phenobarbital grains 11 *bis die*. Very maladjusted and a " terror in the house " from her mother's description. She was showing all the signs of cortical changes. Impossible to influence by the ordinary methods of hypnosis induction. Thiopentone induction very successful. Strong suggestions were given that the fits would take place at night, and would grow less and less in numbers and severity. Monthly visits, when hypnosis was produced at a given signal. After two years she has now very few fits, one or two yearly where they are severe enough for her to bite her tongue. She married and was much better during the gestation period of her child, having no attacks. Under hypnosis it was suggested she would have no pain whatever during her labour. She was taught to relax, and has now been delivered and has had no pain.

C. L., male, age at time of first consultation 10 years. Fits several times a week, especially at class time. Somewhat maladjusted and unable to settle. Weaned off phenobarbitals and put on small doses of epanutin. Successfully inducted by thiopentone. After four monthly visits fits occurred at night only, and were feeble in nature and less frequent. After two years, except for odd attacks, he is free from major symptoms.

Nocturnal Enuresis.

R. T., female, age at time of first consultation 11 years. Brought by her parents because she was found stealing from neighbours. She had a wet bed every night since infancy. Hypnosis, by using thiopentone, and put through a quick psychoanalysis. It emerged she heard voices ordering her to take the money. Suggested that these voices would cease, and she would hear only mine ordering her *not to steal*. Other family difficulties producing feelings of insecurity were righted. She is now, after two years, except for a very occasional lapse, symptom free and has not stolen since first consultation.

J. F., male, age 28, at first consultation. Enuresis since childhood. Is now married and is still afflicted. No physical cause found. Thiopentone induction successful. Symptom free for some months. He bought a business which entailed much worry and anxiety. Symptoms returned and in spite of numerous hypnotic sessions, is still wetting. Psychoanalysis and repeated suggestion of no avail.

Auto-Erotism.

J. D., female, age 25 at time of consultation. Masturbated several times a week. Avoids social male contacts and feels it is due to her habits. She proved

a very bad subject, and was uninfluenced by the ordinary methods of induction. She was put under thiopentone hypnosis. On subsequent visits she entered hypnosis at a sign. Analysis under the state bringing to the surface the cause of her perversion. Under hypnosis she was instructed in a more adult attitude to sex, and a sublimation of her impulses. There has been gradual improvement and now, after two years treatment, she is engaged to be married.

Somnambulism.

These cases need very little induction as they are "naturals", but the following case is of interest.

C. C., female, age at time of first consultation 5 years. Found "walking" in the garden of her home on several occasions. I had an opportunity to induce hypnosis, as shortly after the initial interview she developed acute appendicitis. In hospital she was given a premedication of seconal 1½ grains and atropine 1/100 grain, and induced under intravenous thiopentone. Taking the opportunity to suggest during the hypnotic stage that she would not leave her bed when asleep. This treatment was successful for six months when she had a relapse. Under hypnosis induced "at the sign" she has, after two years, no relapses.

Laparotomy under Hypnosis.

J. I., female, age 27. Was under treatment for anxiety neurosis. She proved a very good subject and was put under hypnosis using the ordinary methods. She sank into deep somnambulism at the given sign after the first induction. She developed signs of chronic appendix, which was confirmed by X-ray. Admitted to hospital and hypnotized the night before operation. She was ordered to have a deep sleep and awake the following morning refreshed. She was also told that an operation would be performed after she was put to sleep the next day, when she would feel no pain whatever and would awake after the operation well and free from pain.

Hypnosis was induced after preparation for her operation. No premedication was given. Blood pressure then 120/90. Temperature normal. Heart and lungs normal. No complaint from the surgeon as to undue muscle contracture on his incision. Patient grimaced slightly on opening the peritoneum, but otherwise remained in deep hypnosis. Blood pressure as above. Surgeon complaining of slight stiffness on stitching the peritoneum, but not sufficient to impede his work. Returned to the ward, her blood pressure fell steeply to 80 systolic and she was showing all the classical signs of shock. Morphia, ¼ grain, given intravenously produced a rapid all-round improvement. No further sedation was found necessary and the patient slept peacefully until morning. Her recovery was uneventful and she states she did not know or feel anything after her induction for the operation.

SUMMARY

Anaesthetists, by their very calling, should not ignore the possibilities of hypnosis. It is as much their instrument as that of the psychologist. There are some unattractive aspects for those working in hospitals. Hypnosis has its uses in hospital. It is suggested that the most useful method for anaesthetists is that of hypno-narcosis using thiopentone. In cases of children, blowing on nitrous oxide or ethyl chloride can be used as an alternative.

CONCLUSIONS

Hypnosis has its place in surgery practice, and in midwifery, where it is seen at its best. It is ideal and safe as a preoperative sedation. The use of thiopentone hypnosis is the method *par excellence* for the anaesthetist.

Brit. J. Anaesth. (1955), **27**, 405

THE USE OF HYPOTENSION IN ANAESTHESIA FOR EAR, NOSE AND THROAT OPERATIONS

BY

C. B. ANDREAE AND H. F. GRIFFITHS

South-East Kent Group of Hospitals

OPINIONS differ vastly and there has been considerable controversy about the usefulness and the advisability of using hypotensive drugs as an adjunct to surgery.

Let us, therefore, at the outset say that, within our very limited experiences (some 370 cases in all), we have formed a very favourable opinion of their use in anaesthesia for ear, nose and throat surgery. Of the papers published so far, few seem to have mentioned their wide field of application in these operations. Scurr and Wyman (1954) record the use of Arfonad in 20 operations upon the mouth, nose and throat, but do not mention the particular advantages obtained. Stirling (1955) described 20 fenestrations using hexamethonium bromide with excellent results.

We have found that the use of this technique provides two great advantages. Firstly, during operation a comparatively bloodless field has made it much easier for the surgeon to see exactly what he is doing, and that has almost halved operating times. Secondly, there has been no pre-operative packing of the nose, which saves the patient a great deal of discomfort. Nor has there been any postoperative packing, which again has greatly benefited the patient. Almost all patients are able to breathe nasally on the first postoperative day and their comparative well-being has to be seen to be believed.

We started using hypotension in this series in 1951 with hexamethonium bromide as the drug of choice, and achieved considerable but not very consistent success. Since April 1954, we have used Arfonad with much improved (and very much more controllable) results.

The total numbers of each drug and the operations for which they were used are given in table I. The results obtained are given in table II. A grading of "V. Excellent" denoted an almost completely dry field. "Excellent", "V. Good", "Poor", and "Failure" indicated lessening degrees of success.

It will be seen that Arfonad gave a very much greater percentage of success than did hexamethonium bromide and for that reason we have now completely abandoned the latter.

ADMINISTRATION

Anaesthesia for all cases has consisted of thiopentone 500 mg, gallamine triethiodide 80 mg, followed by pethidine 25 mg and nitrous oxide and oxygen *via* a cuffed endotracheal tube. In only a few, and those very "tough customers" has a minimum of trichlorethylene been added to the circuit.

TABLE I

	S.M.R.	Mastoid	Caldwell-Luc	Horgan	Polypectomy	Ethmoidectomy (external)	Total
Hexamethonium bromide ...	87	37	36	8	6	8	182
Arfonad	22	14	24	12	1	2	75

TABLE II

Hexamethonium bromide

	V. excellent	Excellent	V. good	Good	Poor	Failure
S.M.R.	0	10	12	32	27	6
Mastoid	0	7	10	13	6	1
Caldwell-Luc	0	6	9	15	6	0
Horgan	0	0	5	3	0	0
Polypectomy	0	0	1	3	2	0
Ethmoidectomy (external) ...	0	3	4	0	1	0

Arfonad

	V. excellent	Excellent	V. good	Good	Poor	Failure
S.M.R.	0	10	6	5	1	0
Mastoid	1	3	4	4	1	1
Caldwell-Luc	6	8	5	4	1	0
Horgan	3	4	5	0	0	0
Polypectomy	0	0	0	0	1	0
Ethmoidectomy (external) ...	1	0	0	0	1	0

All patients were operated upon in a steep reverse Trendelenberg position, some of them tilted before and some after the administration of the hypotensive drug. It seems to make little difference which of these methods is adopted.

The hexamethonium group were all given the drug in divided doses, but all except the first few of those who received Arfonad were given it in a drip of 1 mg Arfonad per ml of normal saline. The latter method has been found to give a less uneven level of hypotension with the short-acting drug.

Arfonad is excreted far more rapidly than hexamethonium and often the blood pressure has returned to its pre-operative level within a few minutes of stopping the drip and flattening the table. On a few occasions the blood pressure has dropped

to as low as 40 mm Hg or less, but has risen quickly by stopping the drip and/or flattening the table.

No ill effects have been noticed from such severe drops, although we do not aim to reduce the systolic pressure below 50–60 mm Hg.

OPERATIVE TECHNIQUE

The submucous resections of nasal septum, and indeed all the nasal operations were done without any preliminary packing. The blood loss in most cases was considerably less than in noses which had been well packed with cocaine and adrenaline before this technique was used, and the surgeon's visibility correspondingly increased. On conclusion of the operation the space between the flaps is sprayed with a solution of thrombin and this has been found all that is necessary to hold them together. The great advantage is that there is almost no postoperative congestion of the nasal mucosa and the patients can breathe through their noses with comparative ease on the first day.

In *Caldwell-Luc* operations the maxillary antrum scarcely bleeds at all and the stripping of the thickened mucosa becomes a much less exacting task.

Trans-antral ethmoidectomy (Horgan's operation) used to cause a great deal of haemorrhage and often it was deemed unwise to do more than one side at a time because of the great blood loss. Since using this technique we have always been able to complete both sides without trouble or upset to the patient.

Mastoidectomies are made much easier and take considerably less time because of the lessened oozing from the bone. Up to date we have seen no case of reactionary haemorrhage.

SUMMARY

An account is given of 257 cases of ear, nose and throat operations using hypotensive technique, 182 with hexamethonium bromide and 75 with Arfonad.

The successes with Arfonad were very considerably greater than with hexamethonium and the action of the former much less prolonged.

No case of reactionary haemorrhage was seen.

The point we wish to stress is that patients are immeasurably more comfortable when this technique is used, with no packing of the nose, than with the older methods.

ACKNOWLEDGMENTS

Our thanks are due to Messrs. Roche Products Ltd., for generously supplying the Arfonad.

REFERENCES

Scurr, C. F., and Wyman, J. B. (1954). *Lancet*, **6**, 338.
Stirling, J. B. (1955). *Brit. J. Anaesth*, **27**, 80.

Brit. J. Anaesth. (1955), 27, 408

AN ANAESTHETIC TECHNIQUE OF USE IN THE RECONSTRUCTIVE SURGERY FOLLOWING PHARYNGO-LARYNGO-OESOPHAGECTOMY

BY

T. T. P. MURPHY

South Devon and East Cornwall Hospital, Plymouth

MODERN anaesthesia, in association with blood transfusion and antibiotics, has opened up fresh fields to surgery. As a corollary, the confidence of surgeons in their anaesthetists tends to put increasing demands upon the skill and ingenuity of the latter. This is a healthy and desirable situation. When, however, a request is made which involves the relinquishment of control of the airway, an anaesthetist is entitled to pause and take stock before acceding to the request.

An anaesthetist may be confronted with such a situation in the reconstructive surgery which is necessary following the operation of pharyngo-laryngo-oesophagectomy. In the interests of asepsis and a clear operating field, unimpeded by rubber tubing of doubtful sterility, with its tendency to kink or become disconnected, such a request on the part of the surgeon is entirely reasonable. This article is an attempt to show how the interests of patient, surgeon and anaesthetist can be satisfactorily met.

STAGES OF THE OPERATION

Prior to dealing with the anaesthetic problems, it may not be out of place to give a brief description of the anatomy displayed when the first stage of the operation has been completed. A rectangular skin flap has been deflected from the anterior cervical region and the underlying hyoid bone, larynx (with a number of tracheal rings), hypopharynx and some inches of oesophagus with the contained neoplasm removed. A total thyroidectomy is also an incident in the operation.

The skin flap is replaced, but now lies against the prevertebral fascia and carotid sheaths. The superior edge is sutured to the mucous membrane lining the posterior part of the gap in the floor of the mouth. The skin of the sub-mandibular region is sutured to the remaining free mucous membrane. The lower edge of the cervical skin flap is attached to the posterior lip of the oesophagus, while the tracheal opening just above the sternum is attached anteriorly to the pectoral skin.

When the dressings are removed for the stage of reconstruction, the spectator is left with a vivid impression of two large raw areas separated by a deep central cleft. Through this cleft runs a feeding tube, from the nares above to the intact oesophagus below. The surgeon's aim is to reconstruct the hypopharynx and oesophagus, using the same cervical skin previously reflected, and now firmly attached to the vertebral region and receiving its blood supply therefrom.

From this skin a tube is formed which,

superiorly at its freed margin, is attached to the floor of the mouth, and inferiorly to the anterior margin of the oesophagus. The oesophagus, in turn, requires to be separated from the posterior lip of the trachea. When this stage is completed, the artificial skin tube now formed is covered by two large skin flaps taken from the anterior triangles and pectoral regions.

At the lower end of the operation field, the restriction of space and peculiar liability to fistula formation makes a clear field of great advantage to the surgeon. It can readily be seen that the presence of any anaesthetic apparatus would add to the surgical difficulties at this stage.

ANAESTHETIC PROBLEMS

The anaesthetic problems now become reasonably clear. They are:

(1) There must be uninterrupted access to the operating field for the surgeon; therefore no tubing is permissible.

(2) Because no endotracheal tube is *in situ*, the patient must retain the use of his own respiratory apparatus.

(3) Respiratory depression must be avoided (*a*) to prevent oxygen lack, (*b*) to prevent CO_2 build-up. In connection with the latter attention is drawn to the remarks of Orton (1952) and Pask (1948) who emphasize that CO_2 build-up can occur with a depth of respiration sufficient to prevent cyanosis. This apparently adequate oxygenation is illusory, and the patient may slowly develop CO_2 poisoning, leading to respiratory depression and death.

(4) No blood must be allowed to enter the trachea. This is important because, though the reflexes may not be completely obtunded, the cough reflex becomes ineffective in the presence of an open tracheotomy.

ANAESTHETIC TECHNIQUE

The intravenous route seems the logical choice for anaesthesia in these circumstances. The phenothiazine derivatives with pethidine were used to produce a form of basal narcosis, and the anaesthesia continued with thiopentone and suxamethonium. The method is as follows.

One hour prior to operation a solution of chlorpromazine, 50 mg, promethazine, 50 mg, pethidine, 100 mg, is made up in 10 ml normal saline and injected deep into the gluteal muscles. Both buttocks are used because of the bulk of solution and to minimize the irritating effects that might be expected to follow the injection. In this objective, full success was obtained.

The patient arrives in the anaesthetic room asleep, but can be roused. Here a solution of the same drugs, in the same dosage, but diluted now in 250 ml saline has been prepared and is administered in the form of an infusion through a vein in the lateral surface of the forearm. At first, the drip is allowed to run freely (130 ml in approximately 10 minutes). The rate of flow is then slowed down, and the whole infusion is given in 25–30 minutes. At this stage the patient is soundly asleep, no longer rousable, but reflexes, e.g. the lash reflex, may still be present.

Thiopentone 1 g and suxamethonium 100 mg are dissolved in 500 ml of normal saline and the bottle connected to the drip tubing already in use. A very slow rate of

flow (20 drops per min) is permitted. The interaction of the thiopentone with the solution remaining in the drip chamber causes a turbidity, which disappears in a matter of seconds.

The patient is now taken to the theatre. In the early stages of the operation it may be found necessary to speed up the drip for one or two minutes. As soon as the patient settles, the earlier rate of flow is resumed. Suitable adjustments are made in the course of operation to meet individual requirements.

Figure 1 gives some details of one patient's condition during operation, who was anaesthetized by the method described. It will be agreed that they provide almost monotonous satisfaction. The slight rise in systolic blood pressure and pulse rate is attributed to some straining and coughing produced by a little blood that had found its way into the trachea. It is emphasized that continual vigilance is necessary on the part of the surgical assistant to avoid this possibility, otherwise the patient's reflexes come rapidly into action and the even rhythm of anaesthesia upset.

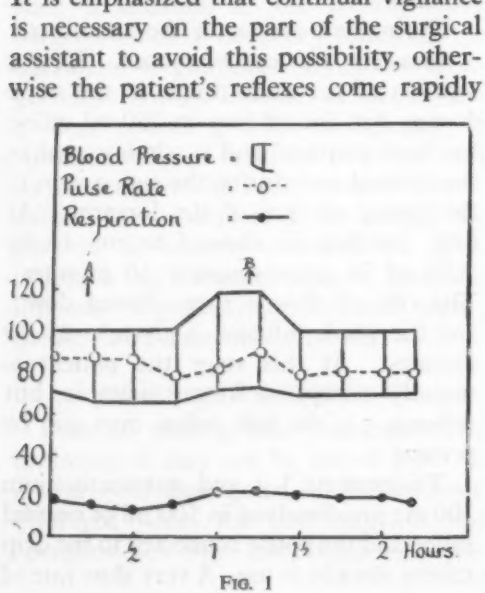


FIG. 1

It is perhaps the smoothness of anaesthesia, which creates the most vivid impression. At no time is the patient's respiration in jeopardy; the rhythm is slow, deep and regular throughout.

Postoperative recovery is uneventful. Signs of returning consciousness are evident in about one hour after return to the ward and full consciousness is present in three hours. Rectal temperature rises slowly from around 96°F. and is normal in six hours. Pulse and blood pressure readings indicate no adverse effect on the cardiovascular system.

It will be appreciated that this type of case is a rarity in a provincial hospital and that the anaesthetist's experience is, in consequence, limited. I have had experience of no more than five cases and, of those five, one only has been anaesthetized by the method described. It must be added, however, that this patient required two further plastic operations to repair a fistulous opening around the tracheotomy, and the same method of anaesthesia was used on those occasions with equally satisfactory results.

DISCUSSION

If it be accepted that anaesthesia by the intravenous route provides the best conditions for this type of surgical operation, the following questions might be asked: Why this somewhat elaborate technique when simpler methods are available?

Intravenous alcohol (3 ml of 90 per cent alcohol per kg body weight) in a 5 per cent glucose solution would secure a light anaesthesia, which would possibly be suitable for this type of surgery (Hewer, 1953).

The writer has some misgivings about its use in the presence of diathermy.

Rectal bromethol with intravenous thiopentone is mentioned to be condemned. Both drugs are respiratory depressants, and the combined effect on the respiratory centre would be undesirable, if not dangerous, when control of the airway has been relinquished.

The writer's experience during the war of continuous intravenous thiopentone was unsatisfactory. Using a 1 per cent solution in saline, it was found that individual variability to dosage, and the rate of degradation made it very difficult to maintain an even level of anaesthesia. Postoperative narcosis was too prolonged.

On the other hand, the basal narcosis produced by suitable doses of promethazine and chlorpromazine allows the use of fractional quantities of thiopentone as supplementation to secure an even plane of light anaesthesia. Eastwood and Harbord (1955) draw attention to the fact that it is possible to produce a satisfactorily spontaneous pulmonary respiration with these drugs. Sufficient has already been written on the properties of these drugs to render unnecessary any further elaboration except to refer to the properties of absence of postoperative pain and discomfort. To a patient, who has undergone the operation of pharyngo - laryngo - oesophagectomy these two factors are of paramount importance and alleviation of his distress will earn his gratitude.

The addition of suxamethonium to the solution of thiopentone may provoke inquiry. The idea behind this was to promote a mild but continuous degree of relaxation, and to obtund the vagal reflexes, thus avoiding straining and coughing. The recently published work of Fraser (1954) on the hydrolysis of suxamethonium salts strongly suggests that the activity of suxamethonium is quickly reduced when used in combination with thiopentone, because of the high pH of the latter. It is questionable, therefore, if suxamethonium has any advantages to offer here.

CONCLUSION

"It could be argued that were anaesthetists to pay as much attention to the problems involved in dealing with oto-laryngological surgery in children and adults as they do those of specialized cardiac surgery, more widespread good for the general community would follow" (Annotation, 1954).

The above is a verbatim quotation from an Annotation on E.N.T. Anaesthesia in a recent number of this journal. It is hoped that the method of anaesthesia described above may be of value in the surgery of the upper air passages and digestive tract, where the anaesthetist is unable to control the airway.

ACKNOWLEDGMENTS

Thanks are due to Mr. D. A. Barley for the anatomical precis, and to Dr. J. A. Smith for assistance with the manuscript.

REFERENCES

Annotation (1954). *Brit. J. Anaesth.*, **26**, 432.
Eastwood, A. B., and Harbord, R. P. (1955). *Anaesthesia*, **10**, 45.
Fraser, P. J. (1954). *Brit. J. Pharmacol.*, **9**, 429.
Hewer, C. L. (1953). *Recent Advances*, 7th ed., p. 145.
Orton, R. H. (1952). *Anaesthesia*, **7**, 211.
Pask, E. A. (1948). *Proc. roy. Soc. Med.*, **3**, 138.

ON CHLOROFORM AND OTHER ANÆSTHETICS

THEIR ACTION AND ADMINISTRATION

BY

JOHN SNOW, M.D.

Licentiate of the Royal College of Physicians

(*Continued from page* 368)

Soon after the introduction of chloroform I administered it to a gentleman, aged about 55, whilst a fatty tumour was removed from the nape of the neck. It did not turn out as fatty tumours usually do, but required to be dissected out. The patient had taken a meal before the operation, and vomited freely afterwards. On his visit the next morning, the surgeon thought his patient going on well. Vomiting returned, however, and the patient became affected with partial stupor and delirium, which his friends attributed to the chloroform. He became covered with an eruption of erysipelas over a great part of the body, had a very rapid pulse with great depression, and died on the fifth day. An examination after death showed that there had been diffuse cellular inflammation around the seat of the operation. A surgeon who assisted at the operation on the above patient, and also at the post mortem examination, removed an encysted tumour from the scalp of an old lady the day following the latter event. This operation was performed without chloroform, but the patient was attacked with erysipelas and diffuse cellular information, and died in three or four days.

Faintness and Depression. Although chloroform acts as a stimulant to the circulation, increasing the force and frequency of the pulse whilst it is being inhaled, it is occasionally followed by a feeling of faintness, especially if the patient remains in the sitting posture. At one period in the history of medical opinion, it would have been said that the depression was a consequence of the previous excitement. The facts, however, would not agree with such a doctrine. The subjects who are most stimulated by chloroform are the strong and robust, and they do not suffer from depression afterwards; whilst the feeble and debilitated, who are most liable to subsequent depression, are but little stimulated by it at the time of inhaling. Some amount of faintness and depression usually accompanies the sickness caused by chloroform, and is in fact a consequence of it, being, like the sickness, most frequent after a full meal. This depression is usually relieved by vomiting. I have met with a few cases in which there has been more decided faintness, and once or twice absolute syncope after chloroform, which was not attributable to loss of blood. In these cases, however, the patients were in the sitting posture, and they recovered from the syncope immediately, on being placed horizontally. The patients most subject to faintness after chloroform are those who are subject to

this affection at other times, being often persons in a state of anæmia, or having the symptoms of fatty degeneration of the heart. Faintness is, however, very much more rare after operations with chloroform than without it. The only cases in which I have seen it follow the use of chloroform in the horizontal position, and where there was no considerable loss of blood, have been two or three of operations on the rectum, performed before breakfast, and after a brisk purgative had been taken the previous night. It might be advisable, where persons in a state of debility have taken a purgative, to make an exception to the usual rule of prohibiting the breakfast, and to risk the inconvenience of vomiting rather than the more formidable symptoms of faintness from inanition.

The faintness which now and then follows an operation under chloroform should be treated on ordinary principles, as the horizontal posture, the application of the vapour of ammonia to the nostrils, and the exhibition of brandy or wine, if the other measures do not suffice. I never give ammonia internally where a patient is sick or faint, but the spirit of sal volatile, when at hand, serves very well to pour on the corner of a towel and apply to the nostrils.

Hysteria. I have already stated (p. 43) that chloroform occasionally excites hysteria in those who are subject to that complaint; and that, in a few cases, the hysteria, which has been subdued by the chloroform, reappears as the effects of the vapour subside. It is nearly always in the female sex that one meets with these phenomena although I have two or three times seen hysterical symptoms in the male for half an hour or so after the inhalation. The hysteria commonly takes the form of laughing or crying, but the patient sometimes remains quiet, and simply in an unconscious state. The hysterical symptoms usually pass off spontaneously, in half an hour or less, without any remedies; if they last longer, the ordinary remedies for hysteria may be applied. I am not aware that the hysteria has lasted longer than three or four hours in any of the cases in which I have administered chloroform, but it may have done so without my being informed of the circumstance. I was informed of the case of a young woman in King's College Hospital, who remained unconscious, or at least apparently so, for three days after chloroform had been administered for an operation, the nature of which I have forgotten. She recovered without ill effects. When the patient does not wake spontaneously, and cannot be roused to the waking state, within twenty minutes or half an hour after the inhalation of chloroform has been left off, we may rest assured that the patient is affected with hysteria—at least this has been the case in every instance with which I have become acquainted. The physical properties of this agent do not permit it to remain long in the system, if the circulation and respiration are going on properly, and this circumstance ought to prevent unnecessary alarm, in the absence of other symptoms except the state of unconsciousness. I have, however, known great alarm to exist where the properties of chloroform were not well understood. Soon after its introduction, a medical man administered it to a young woman in domestic service, for the extraction of a tooth. He became

alarmed, in the first instance, from the impression that he had given an overdose. In a few minutes, however, the patient burst out in a loud fit of laughter, but again became unconscious, and various measures were used to restore her, including even artificial respiration, in the idea that she was still under the influence of chloroform. I was sent for thirty-six hours after the inhalation, and found the patient apparently in a profound state of insensibility, and breathing very feebly. Guided by the considerations mentioned above, I concluded that she was only labouring under hysteria, and that the anxiety of those about her tended very much to keep up the complaint. The anxious attendance on her was discontinued, she took some medicine containing valerian, and became quite conscious in a few hours. I was told, however, that she did not seem quite well for some time.

I am not aware of any permanent ill effects having been produced by chloroform, although, amongst the multitudes of persons who have inhaled it, some have not failed to blame it for symptoms that have occurred afterwards.

A clergyman from the country called on me, in 1852, and the following are some notes I made when he left my room. He is 63 years of age. He said that he had inhaled chloroform about a year ago to have four teeth extracted. He felt very well for about a week afterwards, but on his pupils returning, and his beginning to apply himself to teaching. he became affected with flushings of the face and a rushing noise in his head, which lasted occasionally for a day or two, and have troubled him ever since. An eminent physician, whom he named, prescribed quinine, under the use of which he became worse. An eminent surgeon prescribed infusion of hops, etc., and he has tried other medicines without good effect. He had been recommended to travel, and had been to Switzerland; but the complaint troubled him when at leisure, as well as when applying himself mentally. He could not sleep at night, when affected with the attacks. He is rather deaf, and has been so for three or four years; he was also occasionally troubled with a rushing sound behind the ears before he inhaled the chloroform. He is rather short and rather stout, and has a florid complexion. The pulse was rather feeble. The second sound of the heart was rather louder than the first. In other respects its sounds were natural, but its impulse was not strong. In every respect, except the symptoms above named, the health of the patient was good, and he felt quite well between the attacks.

It was my opinion that the complaint of this gentleman was coming on long before he inhaled the chloroform, and that it depended on a much less transient cause. I have not heard from him since.

CAUSE AND PREVENTION OF DEATH FROM CHLOROFORM

All narcotics are capable of causing death, and the discovery of preventing pain by inhalation consists essentially in in carrying the effects of a narcotic much further than had previously been the custom; there was, therefore, every reason to apprehend that accidents might occur in the new practice, unless the effects of the medicines employed could be very effectually controlled. There are certain circumstances connected with the physiological properties of chloroform, as

ascertained in the experiments previously related, which indicate how accidents may very easily happen with this agent, if not carefully and systematically managed. It was calculated (p. 155) that 18 minims of chloroform is the average quantity in the system of an adult, when sufficiently insensible for a surgical operation, and that this amount might be absorbed by use of 36 minims, allowing one half of the quantity breathed to be exhaled again, without being absorbed; but 36 minims of chloroform make only 37.5 cubic inches of vapour, which, at the temperature of 60° Fah., may exist in combination with 257 cubic inches of air, making it expand to not quite 300 cubic inches; the whole of which might be breathed in twelve ordinary inspirations of 25 cubic inches each. If the inhalation of vapour of this strength were continued till insensibility was induced, the lungs would still contain a great quantity of unabsorbed vapour.

The amount of air usually present in the lungs is about 250 cubic inches, and if saturated with chloroform at the temperature of 60° it would contain the vapour of 30 minims. About half of this might be absorbed, the remaining half passing off in the expired air; but the addition of 15 minims to the 18 minims already absorbed would almost double the quantity of chloroform in the system, and bring the patient necessarily to the brink of death. It is true that, in the ordinary methods of inhalation, the air seldom becomes quite saturated with vapour, and usually is not more than half saturated, or accidents might be of much more frequent occurrence; but the above considerations are sufficient to show that the amount of vapour contained in the air breathed by the patient should not be left to mere accident, such as the varying temperature of the handkerchief from which the chloroform is breathed, or the greater or less extent of wetted surface over which the air passes. It should be recollected also that the patient sometimes draws a deep and sudden inspiration by which he may inspire 100 cubic inches of air, which would contain, if strongly charged with vapour, ten or twelve minims of chloroform—a large quantity to be suddenly added to that already in the circulation, when the patient is insensible, or nearly so.

It is, however, only by a knowledge of the different modes in which chloroform is capable of causing death, that the exact nature of the accidents from this agent can be understood, together with the means of preventing them, and the reason why they are usually irremediable when they happen. If animals are kept for a very long time under the deep influence of chloroform, they become ultimately exhausted, the circulation and respiration are gradually weakened, and cease nearly together. Such a mode of death from this agent is never likely to occur to the human subject, and therefore need not engage our further attention. The following experiments illustrate the different modes of dying, when death is caused more suddenly by this agent.*

* London Journal of Medicine, April 1852.

In one of the latest communications of Dr. Marshall Hall to the *Lancet*, he did me the honour to quote the account of the three following experiments, together with some accompanying remarks from the *London Journal of Medicine*, and to make the following observation respecting the pages from which he quoted.

"I have no hesitation in affirming that the first three pages of this paper are amongst the most able and valuable in physiology, and I beg to be allowed to reproduce them in the pages of the *Lancet*." (*Lancet*, April 18th, 1857, p. 397.)

Experiment 23. A young but full-grown cat was placed in a glass jar, of the capacity of 1,600 cubic inches, and a fluid drachm of chloroform (4%) was introduced, by a portion at a time, through a tube in the cover of the jar. As twenty-five minims of chloroform produce twenty-six cubic inches of vapour, the atmosphere which the cat had to breathe contained nearly four per cent. of vapour, and the jar was moved about, to ensure the uniform mixture of the vapour with the air. In five minutes, the cat became insensible, and lay breathing naturally. In about ten minutes more, the breathing became very feeble, and it ceased altogether in about another minute, or sixteen minutes after the cat commenced to breathe the chloroform. It was immediately taken out and laid on a table, and the stethoscope was applied to the chest. The heart could be heard beating distinctly at first, but the pulsations became slower and feebler, and in about a minute they could be no longer heard. Just at this time, however, the cat took a gasping inspiration, and immediately the heart was heard to beat in a most rapid manner. The gasps were repeated, and the action of the heart became less rapid, but stronger. In a little time, both the breathing and the action of the heart became natural, the cat remaining, however, insensible for some minutes.

Experiment 24. A cat, about the same size as the last, was put into the same jar, and the same quantity of chloroform was introduced. It was removed at the end of four minutes, when it was so far insensible as to offer no resistance. Being laid on the table, it was made to breathe air charged with ten per cent. of vapour of chloroform from a bladder. Twenty-five minims of chloroform were put into the bladder, which held 250 cubic inches (10%) and it was filled up with the bellows. A portion of another bladder, which was attached to the stop-cock, was made to surround the head of the cat, which consequently breathed to and from the bladder. In half a minute it was quite insensible: in about half a minute more the breathing became difficult, and the sounds of the heart less distinct. The breathing became gradually slower, and ceased altogether between three and four minutes after the respiration from the bladder commenced. The sounds of the heart were rather frequent, and scarcely audible, just before the breathing ceased, and they could not be heard afterwards. The chest was opened three-quarters of an hour after death. The lungs were of a pale red colour, everywhere permeated with air, and a small quantity of fluid blood flowed from them on making an incision. The right cavities of the heart were quite full of blood, and the left cavities contained a small quantity.

Experiment 25. A cat was made insensible in the same manner as the two previous ones. As it made strong efforts to get out of the jar, and consequently breathed more deeply, the chloroform took effect sooner; and it was removed and laid on the table, in a passive state, at the end of two minutes and a half. The respiration and sounds of the heart were quite natural. The nose of the animal was placed in the mouth of a metal vessel, lined with bibulous paper, and used as a chloroform inhaler. The inhaler contained chloroform, and was surrounded with water of the temperature of 110°

Fahr. The stethoscope was kept applied to the chest whilst the chloroform was exhibited. After four or five inspirations from the inhaler, the heart suddenly ceased to beat, the breathing still going on. The inhaler was removd as soon as I was satisfied that the action of the heart had ceased, and there were two or three rather convulsive respirations afterwards, and then the breathing stopped; but, between one and two minutes later, there were two or three feeble inspirations, accompanied with motion of the nostrils, but no returning action of the heart could be heard. The chest was opened ten minutes after death. The lungs were quite pale throughout. There was a little clear serum in the pericardium. The heart appeared quite motionless when first observed; but, after exposure to the air for a short time, there were some slight contractions of a few fibres of the right ventricle. The right auricle and ventricle were filled with blood.

The air which this cat breathed must have contained much more than ten per cent. of vapour.

In Experiment 23 the breathing was arrested by the influence of the chloroform on the nervous centres, but the action of the heart continued, until it was stopped, or very nearly so, for want of respiration, as in asphyxia from privation of air. In experiments 24 and 25 the action of the heart was arrested by the direct effect of the chloroform; in one instance at the same moment as the respiration, and in the other instance, even before it.

The paralysing effect on the heart of large doses of chloroform was shown in the first experiments which were made with this substance, viz., those by Dr. R. M. Glover in 1842.* In animals which were killed by injecting it into the jugular vein, the irritability of the heart was found to be destroyed, whilst this organ retained its irritability in those that were killed by the injection of chloroform into the arteries, stomach, or peritoneum. I have frequently arrested the action of the heart remaining in animals which were opened immediately after death, by blowing the vapour of chloroform on it; and I ascertained by some experiments on frogs, that the motion of the heart can be arrested by an amount of chloroform somewhat greater than suffices to suspend the respiration. As absorption of chloroform vapour is continued by the skin of these animals after the respiratory movements have ceased, they can be exposed to the vapour till the action of the heart is suspended by it direct influence.

* Edin. Med. and Surg. Journal, vol. lviii.

(*To be continued*)

Brit. J. Anaesth. (1955), **27**, 418

ANNOTATION

NEWER BARBITURATES

ALTHOUGH it is over 20 years since Waters and Lundy first used thiopentone as an intravenous anaesthetic in man, very few attempts have been made to introduce similar drugs which might overcome some of the disadvantages of thiopentone. The only notable contributions have been the preparation of thialbarbitone (Kemithal) in this country and thiamylal (Surital, Thioseconal) in America.

During the past few years interest has been revived in this subject and it is to be expected that many new intravenous thiobarbiturates will be made available in this country in the near future. The aim of the chemist seems to be to produce a drug from which recovery is more rapid than from equipotent doses of thiopentone. The *N-methyl* and *N-ethyl* thiobarbiturates, described by Swanson and Chen (1955) combine the side to which hexobarbitone and thiopentone owe their brevity of action. Stoelting (1953) has found that N-methyl-thiopentone has about half the duration of action as thiopentone.

Apart from the above preparations the remaining new barbiturates have originated on the Continent. One of these, Inactin (sodium-5-ethyl-5-(methyl-propyl)-2-thiobarbiturate) was described by Tabern and Volwiler (1935) in their original paper on sulphur-containing hypnotics. Its pharmacology has been studied by Kuhnelt (1953) and Nieschulz (1954) and clinical reports show it to be very similar to thiopentone. Baytinal (sodium-5-allyl-5-isobutyl-2-thiobarbiturate) is also not a new drug, as it was described in 1936 by Miller, Munch, Crossby and Hartung. Weese and Kross (1954) have recently investigated its narcotic action and reported their clinical experiences of its use in 350 patients. This was the last contribution made to anaesthesia by Hellmuth Weese who introduced hexobarbitone.

The work of Kopp and Tchouber (1951), Buchel and Levy (1951), and Buchel, Levy and Tchoubar (1953) has produced Thionarcex (sodium-5-ethyl-5-butybethyl-2-thiobarbiturate), also known as J.L.1074, and its oxygen analogue Butylsedal (J.L.991). Clinical reports suggest that Thionarcex is slightly more potent than thiopentone, and that recovery is also slightly more rapid.

By introducing a methyl-th*ioe*thyl in the side chain in Thiogenal, Zima, v. Werden and Hotovy (1954) hoped to accelerate the breakdown of the narcotic, and at the same time liberate methionine which should protect the liver from the toxic effects of the barbiturate. Reiffescheid and Dietmann (1954) and Dietmann (1954) have confirmed the brevity of action of this drug, both in animal experiment and in human volunteers.

Until more extensive clinical trials on the use of these drugs have been published, it is impossible to say whether their claims of brevity of action are of sufficient significance to offer any serious competition to thiopentone. Rapid recovery alone is not enough to warrant the introduction of a new anaesthesia. It must also be as free from side effects as are the present available preparations. Delayed recovery from thiopentone is extremely rare, provided the contra-indications to, and the limitations of, this drug are properly understood. Of much more value would be an intravenous barbiturate which is less highly alkaline, and therefore less irritant to the subcutaneous tissues and the arterial walls, than thiopentone and which is less depressant to the cardiovascular and respiratory systems.

It is hoped that the investigators, to whom are entrusted the clinical trials of these new barbiturates in this country, will be extremely vigorous in their criteria for a satisfactory anaesthetic. A drug which enables outpatients to benefit from the pleasant induction which thiopentone offers would be very welcome, if its use does not appreciably prolong the recovery time. However, anaesthesia for minor operations is generally entrusted to the most junior of the anaesthetic staff, or to the newly qualified house surgeons. Even if recovery from thiopentone were more

rapid it is doubtful if it could be recommended as a routine drug for such inexperienced personnel. It has been said that the disasters after chloroform were common in patients who were having minor operations; unless the new barbiturates are thoroughly studied before being made available commercially, this statement might well apply in the future to intravenous anaesthesia.

REFERENCES

Buchel, L., and Levy, J. (1951). *Anesth. et Analg.*, **8**, 435.
—— —— and Tchoubar, B (1953). *Anesth. et. Analg.*, **10**, 343.
Dietmann, K (1954). *Dtsch. med. Wsch.*, **79**, 1748.
Kropp, M., and Tchoubar, B. (1951). *Bull. Soc. chem. Fr.*, **18**, 30.
Kuhnelt, H. J. (1953). *Sentralb Gynakol.*, **7**, 1292.
Neischulz, O. (1954). *Arznein Forsch.*, **4**, 441.
Reiffescheid, M., and Dietmann, K. (1954). *Dtsch. med. Wsch.*, **79**, 638.
Stoelting, V. K. (1953). *Curr. Res. Anesth.*, **32**, 370.
Swanson, E. E., and Chen, K. K. (1953). *Proc. Soc. Exper. Biol., N.Y.*, **82**, 212.
Tabern, D. L., and Volwiler, E. H. (1935). *J. Amer. chem. Soc.*, **57**, 1961.
Weese, H., and Kross, F. H. (1954). *Dtsch. med. Wsch.*, **79**, 601.
Zima, O., v. Werder, F., and Holtovy, R. (1954). *Der Anaesthesist.*, **2**, 244.

SOCIETY NEWS

THE SCOTTISH SOCIETY OF ANAESTHETISTS

THE Scottish Society of Anaesthetists held its Annual General Meeting at Dunblane Hotel Hydro, Perthshire, from Friday, April 29, until Sunday, May 1, 1955. A company of 100 members, their wives and guests, was present.

The Executive Council for 1955–56 is as follows:

President: Dr. F. G. Gibbs, Edinburgh.
Vice-President: Dr. H. Bruce Wilson, Aberdeen.
Hon. Secretary: Dr. A. G. Miller, Glasgow.

Dr. I. M. Campbell Dewar, Glasgow.
Dr. D. W. Shannon, Edinburgh.
Dr. M. Shaw, Glasgow.
Dr. R. Lawrie, Dundee.
Dr. J. W. Levack, Aberdeen.
Dr. W. Auld, Glasgow.
Dr. F. Holmes, Edinburgh.

Dr. F. G. Gibbs in his Presidential Address deplored the tendency to approach the science of anaesthesia in a purely mechanistic and technical sense and compared this with the more philosophic approach of the ancient Greeks to their patients.

Dr. T. Cecil Gray, Liverpool, was a guest of the Society and spoke about the experimental and clinical work carried out by various members of the staff of the Department of Anaesthetics at Liverpool during the course of " A Day's Work ". Dr. Gray also showed a film made in his department illustrating the technique of Refrigeration Anaesthesia.

The prize which the Scottish Society of Anaesthetists awards annually for the best paper submitted from anaesthetists of Senior Registrar grading and below, was won by Dr. A. H. B. Masson, Edinburgh.

CORRESPONDENCE

Sir,—In my article entitled " Mechanical Ventilation in Thoracic Surgery with a new Pulmoflator " in the May issue of your Journal, I referred to the use of a Waters type canister.

In fairness to Dr. Williams, who designed the apparatus to function without an absorber, I feel I ought to enlarge on this point.

While placing on record the fact that I had used the apparatus in this fashion, I do not wish to imply that it is desirable to do so. The reverse is actually the case, for the dead space inside the particular canister I used, when full of soda lime, is 150 ml. If the Pneumoflator is running on a total flow rate of 15 litres of gases per minute, and the inspiratory time is 3 sec, then 750 ml of gases are passed to the patient during inflation. Where the inflation volume is less, as for children, the dead space will assume a larger proportion. Similarly, owing to the varying lengths of corrugated hose, the inner supply tube may not reach the patient's end in which case the dead space is even further increased.

I am sure Dr. Williams would wish me to emphasize that it is neither necessary nor desirable to use an absorber with the apparatus and that care should be taken to see that the inner supply tube reaches the patient's end of the rebreathing hose.

T. DINSDALE

BOOK REVIEW

Pathology and Physiology of Breathing in Lung Surgery. By Dr. Med Maurath. Published by Georg Thieme. Price D.M. 19.50.

After a short review of the development of surgery of the lung and the functions of the lung, methods were indicated with which it was possible to gain insight into the workings of the lungs. The following were used:

1. Spirometry after Knipping, the knowledge of whose technique was presumed known. The most important factor in determining the respiratory reserve was considered to be the maximum breathing capacity.

2. Gas analysis of arterial blood.

3. Broncho-spirometry, after Araud, with a specially developed bronchial blocker. The other methods of spirometry are mentioned.

4. The adrenalin test after Rossier was used to expose discrepancies between the percentage values of vital capacity and maximum breathing capacity.

5. The Tiffenau test which shows the useful role of the vital capacity and the firm relation to the maximum breathing capacity.

The techniques of the different methods of examination are described.

1. In some of the patients with lung disease, it was proved that in spite of hyperventilation and normal arterial CO_2 saturation the CO_2 values were raised. This CO_2 retention appears to be the first symptom of gaseous exchange in some of those with diseases of the lung.

2. In the so-called "O_2" experiment during 5 minutes O_2 inhalation, the O_2 content and tension were raised and the pH fell in patients with chronic hypoxaemia. In spite of that, there followed a reduction in the lung ventilation. The associated problems of regulation of breathing were discussed, and it became apparent that the cause of diminished ventilation when the O_2 tension was raised by O_2 inhalation was that the tonus of the Carotid sinus was raised and for that reason the additive effects of the increased CO_2 tension and diminished pH could produce no action.

To clarify these questions note was taken of spirometry readings, blood analysis and circulation times during 30 minutes O_2 inhalation while rates of breathing were recorded. These experiments lead to the following conclusions.

(*a*) During O_2 inhalation the arterial concentration rose to 100 per cent when there was no vascular short circuit. The O_2 level did not always reach optimum values and thus showed the degree of gaseous exchange disturbance.

(*b*) During air respiration which followed the O_2 inhalation hypoxaemia occurred in the arterial blood. The O_2 tension was parallel with these findings.

(*c*) In the healthy and those with minor lung disease, the CO_2 values rose during O_2 inhalation and swung again to normal values. In cases of greater hypoxaemia the values rose continually with marked acidaemia. During air respiration improvement occurred.

(*d*) During O_2 inhalation there was often a decrease in lung ventilation in spite of the raised O_2 values and lowered pH.

(*e*) O_2 inhalation led to a decrease in stroke and minute output of the heart, diminished blood pressure and peripheral vasoconstriction. During the following air breathing, these changes returned again to resting values.

The following were regarded as absolutely necessary functional examinations of the lungs:

(*a*) Spirometry after Knipping whereby the importance of (Tiffenau) test became apparent.

(*b*) Broncho-spirometry, so that postoperative respiratory deficiency is prevented.

Arterial blood gas analysis was not particularly necessary, but it gave good insight into the gaseous exchanges of the lungs.

M. Fox

Printed in Great Britain by JOHN SHERRATT & SON, Park Road, Altrincham